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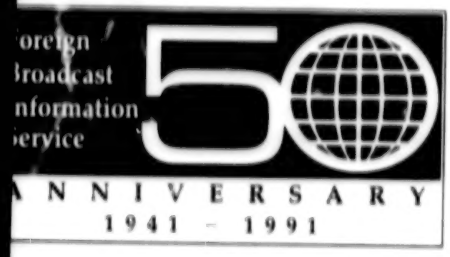

JPRS Report

Science & Technology

USSR: Space

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Cosmonauts Install Telescoping Booms During 26 Jan EVA

LD2601171591 Moscow TASS in English 1704 GMT 26 Jan 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow January 26 TASS—Soviet cosmonauts Viktor Afanasyev and Musa Manarov have just returned to the Mir orbital complex, at which they have been working for about two months, a spokesman for the Mission Control Center has told TASS. Today at 1200, Moscow time, the crew left the orbital station in order to do assembly work in outer space.

The program has been fulfilled completely. It was the third spacewalk of the cosmonauts. A total of four spacewalks are planned for the crew of the eighth main expedition.

This time the cosmonauts continued assembly work on the outside surface of the Mir orbital station within the framework of preparations for moving solar batteries from the Kristall module to the Kvant astrophysical module.

They installed on the Kvant astrophysical module two telescopic booms, needed for carrying out assembly work on the orbit. The first boom was moved out of the orbital complex on January 23, and today the crew moved out and installed the second boom on the Kvant astrophysical module. They also performed other operations in outer space, specifically, installed laser reflectors for navigation purposes.

The crew returned to the orbital complex at 1820, Moscow time, after spending in outer space six hours and 20 minutes.

Cosmonauts Install Supports for Solar Panel Repositioning

PM3001125791 Moscow Central Television First Program Network in Russian 1800 GMT 26 Jan 91

[Report by P. Orlov; from the "Vremya" newscast]

[Text] [Announcer] Cosmonauts Musa Manarov and Viktor Afanasyev have been engaged in extravehicular activity [EVA] for six hours and 20 minutes—almost a full working day.

[Orlov] Our cosmonauts' EVA's are now as regular as episodes of a TV soap opera. On Wednesday they installed and tested the "Strela" cargo crane. And today they used it to transfer and install supports [opora] for the "Mir-Kvant" solar battery and laser reflectors for the new docking procedure. And whereas on Wednesday Musa Manarov was the first to fly on "Strela" today Commander Viktor Afanasyev attached himself to it and accompanied the payload. And Musa was working as the crane operator. And it seems he got in the picture. [indistinct passage comprising cosmonauts' exchanges] Yes, even in space ports the crane operators' maneuvers are the same as on earth. But, thank God, they are a long way away from being Odessa dockers, both literally and metaphorically. Here is how their closest colleagues—the U.S. shuttle astronauts—worked with their manipulators to catch a faulty satellite. We won't argue about who's better. In both cases the technical work was of an exceptionally high standard. Today mission control is even proposing that the cosmonauts draw up their own work schedules. But this, so to speak, is a matter for space statisticians and historians. Today, I would like us to remember the striking view of earth from the station—just the way that our cosmonauts, floating above it on a 13-meter carbon-fiber [grafitovyy] needle, have been seeing it.

'Mir' Cosmonauts Continue Research Projects

LD2901183491 Moscow TASS in English 1815 GMT 29 Jan 91

[Text] Mission Control Center January 29 TASS—Soviet cosmonauts Viktor Afanasyev and Musa Manarov continue the planned work on board the orbital complex Mir.

Today's research under the flight program includes the study of X-ray, gamma-ray and neutron radiation sources of extra-terrestrial origin and experiments to determine the effect of open-space factors on structural materials.

The crew will carry out several series of observations and video filming of terrestrial surface to determine the ecological condition of individual regions of the planet.

Under the routine maintenance plan, the cosmonauts are to replace life-sustaining system elements that have exhausted their service length by new ones brought by the Progress M-6 cargo spacecraft.

Mir Cosmonauts Continue Experiments

LD0802151191 Moscow TASS in English 1358 GMT 8 Feb 91

[TASS report from Mission Control Center]

[Text] Moscow February 8 TASS—Soviet cosmonauts are completing another week of work aboard the Mir space station.

Under the flight program, Viktor Afanasyev and Musa Manarov are undergoing comprehensive medical examinations. It includes checking the operation of the cosmonauts' cardiovascular system during their lengthy stay in zero-gravity, hearing and biochemical research.

The crew will also conduct several experiments to evaluate the dynamics of the change in the gas medium in the space station's living compartments.

The process to grow the monocrystal of [gallium] arsenide, begun on February 2, is continuing on the Gallar

plant. The cosmonauts control the operation of the technological plant's automatic systems and temperature in the electric heating furnace.

The flight is proceeding as scheduled.

Cosmonauts Conduct Materials Research, Observations

LD1502171291 Moscow TASS in English 1326 GMT 15 Feb 91

[Text] Moscow February 15 TASS—The second part of the working week of Soviet cosmonauts Viktor Afanasyev and Musa Manarov on board the orbital complex Mir is devoted mainly to space technology research.

The crew carried out yet another non-crucible melt on the Optizon installation in which specimens of semiconductor materials are heated by a focused flux of radiant energy from electric light sources, mission controllers said.

Under the program for the study of materials in space, the cosmonauts also performed a series of experiments with the use of Pion equipment. The aim of the research was to further study the peculiarities of heat mass transfer processes in model liquids in zero gravity and to obtain additional data for use by the developers of technological installations.

Afanasyev and Manarov regularly make observations and videofilm terrestrial surface to evaluate the ecological condition of the individual regions of the planet.

The flight of the manned orbital complex mir is proceeding according to schedule. Both cosmonauts are feeling well.

Cosmonauts Study Heat-Mass Exchange in Materials Production

LD2202133191 Moscow Domestic Service in Russian 1100 GMT 22 Feb 91

[Text] Viktor Afanasyev's and Musa Manarov's space flight is continuing. The Flight Control Center reports that the last two days of the working week on board the Mir complex have been devoted to research within the framework of a program for space studies of materials. The crew carried out a series of experiments on the Pion installation to study the effect of alternating dynamic loads, generated by the operating equipment at the complex, on the processes of heat-mass exchange in model liquids. Simultaneously, the testing of structural elements making it possible to diminish the effect of these factors on the quality of semiconductor materials developed in weightlessness is being carried out. It is a very complex program.

The flight proceeds in accordance with the schedule; the cosmonauts feel fine.

Cosmonauts Continue Mir Mission

LD0403161791 Moscow TASS in English 1530 GMT 28 Feb 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow March 4 TASS—Soviet cosmonauts Viktor Afanasyev and Musa Manarov are today implementing an experiment on studies of dynamic processes in weightlessness. In addition, the crew are doing maintenance work at the Mir research complex.

The cosmonauts have been working for three months today in orbit. Together with Japanese reporter Toyohiro Akiyama, they came to the Mir complex on last December 4 to relieve their colleagues Gennadi Manakov and Gennadi Strekalov.

During this period, in addition to joint work as members of the mixed team, they have fulfilled extensive program of nature-study, technological, medicobiological and astrophysical experiments and studies in the interests of Soviet economic sectors.

The cosmonauts worked in open space three times. During their first space walk-out on January 7, they repaired the outside hatch of the Kvant-2 module, which was a great headache for cosmonauts and specialists.

During the two following walk-outs on January 23 and 26, Afanasyev and Manarov installed two folding telescopic jibs on the astrophysical module Kvant to continue work in space, including work to shift solar batteries.

Specialists believe that the cosmonauts did a good job outside the station. This is corroborated by the fact that they needed three days to do work planned for four days.

The eighth main expedition will continue until next May. On May 12 they will welcome a mixed crew, including a British representative, most probably Helen Sharman. Sharman and Timothy Mace, British candidates for a space mission, are now training at the Gagarin Cosmonaut Training Center near Moscow.

Afanasyev and Manarov Complete Third Month in Space

LD0103114191 Moscow TASS in English 1120 GMT 1 Mar 91

[Text] Mission Control Center March 1 TASS—Soviet cosmonauts Viktor Afanasyev and Musa Manarov are winding up their third month of work in space.

Today, the crew is performing another series of experiments on the Pion plant further to explore the heat and mass exchange process in zero gravity and obtain additional information for engineers developing advanced equipment.

The cosmonauts used the propulsion unit to correct the space station's orbit. Its parameters now are as follows:

- maximum distance from the earth's surface - 399 kilometers

- minimum distance from the earth's surface - 372 kilometers

- period of revolution - [92.1] minutes

- orbit inclination - 51.6 degrees.

Work aboard the space laboratory continues.

Cosmonauts Mark 100th Day in Space

LD1203172991 Moscow TASS in English 1047 GMT 12 Mar 91

[Text] Moscow March 12 TASS—Viktor Afanasyev and Musa Manarov have been working in space for 100 days today.

Under the flight program, the cosmonauts will today carry out technical and astrophysical experiments and prepare scientific equipment for future explorations.

To determine the atmosphere's physical characteristics around the Mir research complex, the cosmonauts are conducting the "Diagramma" experiment. Measurements are being taken with a magnetic-discharge sensor put out into outer space with a jib through an air lock.

Using instruments installed on the outer surface of the Kristall module, the crew will today carry out several investigations of space radiation spectrums.

The space mission continues.

Destructive Reentry of 'Progress M-6'

LD1503214391 Moscow TASS in English 2136 GMT 15 Mar91

[Text] Moscow March 16 TASS—A TASS correspondent learned from the Mission Control Center that the flight of Progress M-6 automatic transport ship was completed on Friday. The ship delivered over two tons of various cargoes to the "Mir" orbital complex.

The transport ship separated from the manned station at 15 hours 47 minutes Moscow time. After braking by means of the engine the ship passed on to the descent trajectory, entered dense layers of the Earth's atmosphere and burned there.

'Progress M-7' Launched 19 Mar

LD1903181991 Moscow TASS in English 1726 GMT 19 Mar 91

[Text] Moscow March 19 TASS--An automatic ferry spacecraft, Progress M-7, was launched in the Soviet Union today at 16:05 Moscow time to ensure the continuation of planned work on board the Mir space research station.

The spacecraft's mission is to deliver expendable materials and other cargo on board the Mir station.

The craft is also carrying a ballistic capsule in which materials with results of research will be returned to earth.

The Progress M-7 spacecraft has been launched into the orbit with the following parameters:

—Maximum distance from earth's surface—230 kilometers,

—Minimum distance from the earth's surface—190 kilometers,

—The period of revolution—88.4 minutes,

—Inclination—51.6 degrees.

According to telemetric information, the on-board systems of the Progress M-7 spacecraft operate normally.

'Progress M-7' Fails To Dock With 'Mir'

LD2103163191 Moscow All-Union Radio Mayak Network in Russian 1430 GMT 21 Mar 91

[Excerpts] [Announcer] As we have already informed you comrades, the latest Progress-M freight craft should have docked today with the Mir orbital complex, where Musa Manarov and Viktor Afanasyev have been working for three months. To be more precise, tomorrow is the 110th day of their flight. The docking should have been taking place at exactly this moment. As our special correspondent Leonid Lazarevich has just come into the studio, one can assume that everything was all right, or...[hesitates]

[Lazarevich] [passage omitted] The docking should have taken place at 1728 [1428 GMT] but it did not take place. Evidently, there were some inaccuracies in the work of the approach systems. Safety is the main thing in space flights. The system that is designed to avoid a collision between spacecraft took the Progress ship away; it took it to one side. Telemetric information continues to come from it. The cosmonauts seem to be able to observe it; it seems they can see it. There was a conversation with Vladimir Alekseyevich Solovyev, who is in charge of the flight, and he said that at the moment the Flight Control Center is analyzing all incoming information, thinking, and making decisions, and it is possible that the docking will be set for tomorrow. [passage omitted]

But I would like to tell radio listeners: No, the docking did not take place. But I would like to remind them that it is not the first time that a module has approached—you remember the case before 12 April, I think, when a module approached the station and did not dock with it. Another attempt was made and the docking took place. Well, so far today the Progress ship is in autonomous flight.

Docking Postponed Until 23 Mar

LD2103192891 Moscow TASS in English 1913 GMT 21 Mar 91

[Text] Moscow March 21 TASS—The Progress M-7 space ferry was blasted off on March 19.

Under the ferry's flight program, two maneuvers were made for its rendezvous with the Mir space station. But the rendezvous system switched off automatically at a distance of about 500 meters.

The docking of the spacecraft was postponed until March 23.

Commnents on Postponement of 'Progress M-7' Docking

LD2303160891 Moscow All-Union Radio Mayak Network in Russian 1408 GMT 23 Mar 91

[Text] [Announcer] On the line with us is the Flight Control Center. Over to our special correspondent, Vladimir Bezyayev.

[Bezyayev] You can probably hear me alright, can you?

[Announcer] Yes, yes.

[Bezyayev] Well, alas, the news is not very pleasant! We observed the freighter approach the station and was almost five to seven meters away when suddenly the image on the television screen floated away somewhere to the left. That means that the ship's computer system decided to postpone the docking, to take the ship away, and, honestly speaking, we were almost a little beside ourselves here when it looks, from the camera, as if the ship is going to cut into the side a little bit. But that is how the electronics work.

The docking has been postponed at the moment. The ship is approximately 50-100 meters from the Mir orbital complex and the Flight Control Center is now making a decision. But, well, Leonid Lazarevich and I are obliged to turn to specialists to find out how things are going. Well, here is the latest from Leonid Lazarevich.

[Lazarevich] You know, the docking was calculated so that it could be carried out tomorrow, too, just in case. Well, Vladimir Solovyev, the flight leader, has just said that there is fuel for a docking tomorrow. But this evening and tonight the Flight Control Center will analyze the information. So far, it is believed that there is no pitch control [net upravleniya po tangazhu], and therefore, the docking could not take place. But the specialists will think and work. They have got the day and night ahead of them and, obviously, it must be presumed that an attempt at a new docking will be made tomorrow.

[Announcer] Well, of course that is distressing. But, nonetheless, we will hope for success. Thank you. Those were my colleagues Vladimir Bezyayev and Leonid Lazarevich from Flight Control Center.

Cosmonauts Redock 'Soyuz TM-11' at 'Kvant' Module

LD2603135891 Moscow TASS International Service in Russian 1320 GMT 26 Mar 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow, 26 Mar (TASS)—This TASS correspondent was informed at the Flight Control Center that this afternoon the redocking of the Soyuz TM-11 spaceship from the docking unit of the main module to the one located on the Kvant astrophysical module, where cargo craft usually dock, was carried out successfully.

To be able to do this the Soviet cosmonauts Viktor Afanasyev and Musa Manarov, who have been working on the Mir orbital complex for nearly four months, left the station for a while and moved into the Soyuz TM-11 craft. They flew around the entire complex, and then approached Kvant in automatic mode.

It was important for the crew to establish the fault, as a result of which the Progress TM-7 cargo automatic craft failed to dock twice—21 and 23 March. Progress was launched on 19 March.

Experts note that all redocking operations were successful. The docking of the Progress TM-7 with the Mir complex is to take place on 28 March.

'Progress M-7' Docking Difficulties Detailed

PM2903151191 Moscow KRASNAYA ZVEZDA in Russian 29 Mar 91 First Edition p 3

[Colonel M. Rebrov report: "Unorthodox Situation in Space"]

[Text] Flight Control Center—It is possible that the word "unorthodox" does not fully describe what happened. There were many worries and a lot of concern. The failure of the Progress M-7 cargo craft to dock with the orbital complex jeopardized the further implementation of the work program. The Progress carries almost 3 tonnes of freight needed by the crew currently working in space and those who will continue the experiments and research in orbit—to be specific, the international expedition whose launch is scheduled for 12 May.

The first attempt undertaken 21 March was unsuccessful. The Kurs automated approach and docking system, detecting the discrepancy between the parameters fed into the computer memory and the actual data of the crafts' approach, "refused" to proceed. Something similar recurred 23 March. However, the situation did not develop as some of my colleagues described it. There was no threat of a catastrophe. There was something different.

This is what I want to tell you about. Our attitude toward the professionalism of those who are in charge of the flight and who work in space is sometimes very offhand. An extraordinarily complex situation developed. I will

not try to say how many possible options there were. But having assessed the situation, they worked out the likely cause, and then they rehearsed their further steps on the "life-size model."

Cosmonauts V. Afanasyev and M. Manarov undocked the Soyuz TM-11 craft from the orbital complex and circled around it from the diection of the Kvant module. Here too the first attempt failed, but the change to the standby unit ensured the docking. The assumption that the Kvant's antenna had moved was fully vindicated.

All these days and nights were very tense for the flight control specialists and for the designers of the crafts and the station and its modules—in short, for all the ground staff. They were just as stressful for the cosmonauts. It is here that the professionalism of those whom we (yes, I mean all of us) have entrusted with working on the exceptionally complex and expensive space equipment demonstrated itself. Their ability to analyze and find correct solutions was confirmed by the entire course of their further actions.

The flight leadership took the decision to "repeat" the docking of the Progress M-7 (by now third attempt) today, 28 March, at 1505 hours, but approaching on this occasion from the direction of the "port" where the Soyuz TM-11 had hitherto been docked. Naturally, there will be difficulties with unloading and with the transfer of fuel. But these are difficulties of a completely different nature. They are surmountable.

One final clarification. Flight control was only slightly out, the docking took place at 1503 hours.

TV Shows Near-Collision of 'Mir', 'Progress M-7' Cargo Craft

LD2803232891 Moscow Central Television First Program Network in Russian 1800 GMT 28 Mar 91

[Report by correspondent P. Orlov, from the "Vremya" newscast]

[Text] At 1503 today a Progress-M cargo craft docked with the orbiting Mir station. This has become an ordinary event, but on this occasion it is worthwhile giving a more detailed account.

[Orlov] We have grown accustomed to flights by the cargo spacecraft, and truthfully, when this one was first unable to approach the station no great attention was paid to it.

It was for this reason that what occurred on Saturday [23 March] during the second attempt can be called a bit of a shock. Only during a nightmare can such a picture be imagined. A multitonne truck moves at full speed into a gate that is, for all intents and purpose, only drawn on the wall of one's residential block. Obeying its automatic equipment Progress-M was moving toward the docking unit. You can indeed see the figures on the screen. They said that everything was in order, but the people watching the screen could not believe their eyes. The cargo craft was obviously not moving to the right spot and it was only just 20 meters from the station—the figure in the lefthand corner is accurate. Later the fact emerged that two parameters contained a catastrophic error, and it was a time when people believed themselves and not the machine.

In translation that command means that they had slammed on all the brakes, or in motoring parlance, they had put both feet down to the floor. The cargo craft turned away and passed within 12 meters of the station, miraculously gliding past the antennass and the solar battery. Thank goodness that it had approached the Mir station on the side that did not have the two 20-meter modules. Otherwise it is better not to say what would have happened in orbit to the station and the two cosmonauts.

By Tuesday [26 March] a decision had been made. Viktor Afanasyev and Musa Manarov should test this docking unit on their own craft, which indeed they did. With certain rectifications it would be able to function. It turned out that all the trouble lay in one of the antennas of the Kurs system. It was precisely this antenna that had drawn the gate on the wall of the residential block. Here you see it on your screens, and this almost cost the lives of the crew and the entire station. What happened precisely still has to be ascertained.

The next expedition of Anatoliy Artsebarskiy and Sergey Krikalev very nearly became unemployed. It is most likely that they will be the ones who will repair this system.

So the point was not that the cosmonauts' food might not suffice, as the newspapers said. It was all much more serious, unlike today when this 50th cargo craft finally docked with the station and delivered gifts for Viktor Afanasyev and Musa Manarov, who had celebrated their birthdays in space. They have now each done this twice.

'Progress M-7' Docks Successfully 28 Mar

LD2803155491 Moscow TASS in English 1455 GMT 28 Mar 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow March 28 TASS—The Progress cargo spacecraft successfully docked with the Mir orbital research complex two and a half hours ago. The crew of the 8th main expedition, consisting of Viktor Afanasyev and Musa Manarov, is now working at the orbital station.

The cargo spacecraft was launched on March 19, and initially it was planned that it would dock with the orbital complex on March 21, according to a traditional two-day scheme. But Progress failed twice to dock with the orbital station—on March 21 and March 23. Then it was decided at Mission Control Center to redock the

Soyuz TM-11 spacecraft from the airlock to the Kvant module, with which cargo spacecraft are usually docked. It was confirmed during the operation that this unprecedented situation was caused by the failure of the antenna of the astrophysical module Kvant.

A spokesman for the Mission Control Center said that the cargo spacecraft had been docked with the airlock of the basic unit, i.e. at the place from which Soyuz TM-11 was removed.

The cargo spacecraft brought to the Mir complex various materials and cargoes, necessary for the continuation of the expedition, including those needed for the work of an international Soviet-British space crew. Its start is planned for May 12, this year.

Backgrounds of Cosmonauts, Flight Plan of Eighth Main Expedition to Mir

917Q0030 Moscow KRASNAYA ZVEZDA in Russian 29 Nov 90 First edition p 3

[Article by Colonel M. Rebrov: "The Eighth Expedition. What Is Next?: The Baykonur Space Launch Facility Is on a Direct Line With the Editorial Office"; first two paragraphs are KRASNAYA ZVEZDA introduction]

[Text] **A similar question was posed to the State Commission when the seventh expedition to the Mir orbital complex blasted off. At the time, Lt. Gen. Avn. V. Shatalov, director of the Cosmonaut Training Center, replied: "The eighth will come after the seventh—its launch is planned for early December." Today, the exact date of lift-off from Baykonur is known: Sunday, 2 December. And the time at which the Soyuz launch vehicle will begin its trip to installation orbit, with a transport spacecraft of the same name and the designation TM-11, is 1113 hours.**

On 12 November, in the evening, after the meeting of the Interdepartmental Commission that was held in Zvezdnyy, the names of those making up the main and backup crews were given, but with a stipulation: the final decision would be made at the space launch facility by the State Commission. But the State Commission did not make changes in the initial version.

And so, here is the eighth expedition. The commander of the main crew is Col. Viktor Afanasyev (call sign "Derbent"). He is 42 years old and a native of the city of Bryansk. In 1970 he graduated from the Kacha Higher Military Aviation School of Pilots imeni A. F. Myasnikov, and 10 years later received an engineering degree from the Moscow Aviation Institute. In the Armed Forces, since September 1966, the job categories in his service record seem quite modest—student pilot, pilot, senior pilot, flight commander. But there is also an something else: senior test pilot. And just what does that mean? The commander is a veteran pilot, his military and test-pilot qualifications are rated as first class, he has flown more than 40 types of modern aircraft, he has a master rating for the MIG-29 and MIG-31 supersonic fighters, and he has more than 2,000 hours of total flying time. And while he was training for this space flight, he didn't stop flying. According to the statement by General Shatalov, Afanasyev is one of the potential candidates for the future crew of the Buran space shuttle.

What else can be said about the 70th Soviet cosmonaut? He is a man of few words, outwardly he seems reserved, at times even austere. Those, who are closely acquainted with him through work, are of the same opinion: he is cool-headed in critical situations, his character is strong and courageous, and he is a person with a kind and pure heart.

Viktor Mikhaylovich is married and has two children. He once admitted to me: "I chose this occupation myself. Our work is attractive, but also risky. I just love this work."

Flight Engineer Musa Manarov also likes his work. This is the second flight for him. His first tour of duty in space on the Mir complex was completed two years ago (in December 1988) and lasted exactly a year. He is a deputy of the Russian Parliament and by service "rank" is a cosmonaut instructor. To the question of journalists "Is it possible to live and work in space for one-and-half years?" he answered confidently, "It is possible." But after a brief pause he added: "But is that necessary now? The optimum duration of an expedition, in my opinion, is four-six months."

Musa Manarov did not conceal the fact that "returning" to the customary conditions on the ground after so long a stay in weightlessness is considerably more difficult than adapting to the very unique conditions of space flight. The experience of such a long period of work on the Mir complex also gave him much for the coming voyage. "The crews come up with a lot of 'tricks' that help to make efficient use of the flight time" is how he puts it.

The eighth expedition is an international one. Along with the Soviet cosmonauts, a Japanese citizen, Toyohiro Akiyama, will go into orbit. He is 48 years old, he graduated from the International Peasant University, he is a journalist by occupation and a staff member of TBS, the largest private television broadcasting corporation in Japan. At one time he was in charge of its bureau in Washington, and now he works as deputy chief of the international information division of the TBS news service.

The backup crew consists of Military Pilot First Class Lt. Col. Anatoliy Pavlovich Artsebarskiy, Sergey Konstantinovich Krikalev, who has already been in orbit, and Japanese journalist Rioko Kikuchi, a staff member of the same [TBS] television company.

The eighth expedition will work at the orbital complex until 20 May 1991. During that time, a program of 150 experiments (perhaps, their number will be increased) is to be performed. A special place is being given to biotechnology and research on the production in space of

unique biomedical preparations, ultrapure substances, and so on. Today, the first steps are being taken toward the establishment of in-orbit industrial plants for the manufacture of products that will play a substantial role in the economics of the ground-based economy.

Several EVAs are planned: one already this year, three or four next year. The cosmonauts will continue the work associated with the repair of the "ill-fated" hatch, as well as with the installation of additional solar panels.

The transfer of the watch in space will begin during the first days of the joint flight of the "Vulkans" and "Derbents" on the orbital complex. The return to earth of T. Manakov, T. Strekalov, and Toyohiro Akiyama is planned for Monday, 10 December. According to preliminary calculations, the time of touchdown will be 0905 hours.

Such is the eighth expedition to the Mir complex—the program and the people. What is next? USSR Academy of Sciences Corresponding Member Yu. P. Semenov, who is general designer of the Energiya Scientific Production Association, responded as follows to that question: "The ninth expedition. With its own program, its own objectives. The outfitting of the Mir orbital complex has not yet been completed. A great deal of interesting and, at the same time, very important work lies ahead."

I will repeat: The launch of the Soyuz TM-11 is slated for 2 December.

Japanese Flight Should Lead to Broader Selection Criteria for Cosmonauts

91?Q0031 Moscow IZVESTIYA in Russian 5 Dec 90 Union Edition pp 1, 2

[Article by IZVESTIYA special correspondent B. Konovalov, Flight Control Center: "Space for Dilettantes?"]

[Text] Docking is the most exciting moment for a cosmonaut after the launch. And here on the large screen of the Flight Control Center, the docking unit of the enormous Soviet space complex grows in size.

"There is contact."

General applause breaks out in the hall, where today it is particularly crowded.

The Japanese space project is commencing a series of commercial flights of cosmonauts on Soviet spacecraft. Prior to this, 15 representatives of various countries had already been in space aboard Soviet space vehicles. The United States has also made its "Shuttles" available for flights of foreign astronauts, but has charged about $25 million for each such voyage. We made our hardware available free of charge, for the sake of increasing the prestige of the socialist camp. In fairness it must, in fact, be noted that every flight was also a matter of prestige for the country that was trying particularly to develop scientific equipment for work in orbit and to conduct serious experiments. Two flights of French cosmonauts, which were conducted under the aegis of a state organization—the National Space Research Center of France—were also organized on that basis.

Prior to this flight, Japan cooperated closely in space research only with the United States. Now, like France, it is pursuing a policy of simultaneous cooperation both with the United States and with the Soviet Union. United Germany, which plans flights of its astronauts on both American and Soviet craft, is also embarking on that path.

Our traditional allies—the countries of the not yet officially dissolved Council for Mutual Economic Assistance—thus far are not withdrawing from space research, but they are now pursuing mainly the organization of individual scientific projects. They will hardly be able in the immediate future to pay for a flight of their own cosmonauts in hard currency. Although the USSR Glavkosmos considerably less charges for such an undertaking than does United States, it is still quite a significant amount in dollars. So our manned space program is taking the first steps in the direction of a market. Of course, what it is beginning to get is thus far only a negligible percentage of what it gets through budget appropriations, but the trend has already begun to show clearly. Next year two more commercial trips are supposed to take place—representatives of England and France are supposed to work aboard the orbital complex.

The commercialization of space also destroyed the long cultivated myth that only supermen, with super health, could work in orbit. Toyohiro Akiyama—a 48-year-old international affairs journalist who in the past was a smoker and did not abstain from alcohol—in a little more than a year underwent sufficient training to do his job alongside professionals from two groups who actually had a monopoly on space flights. If you look back at the past, you see that virtually all the Soviet cosmonauts were either representatives of the Air Force or staff members of the present Energiya Scientific Production Association, formerly "Korolev's firm." No matter how much respect we have for them, it is clear that such a monopoly narrows the possibilities of the choice of cosmonauts. The Japanese had to pay only a few million in foreign currency to prove that practically any healthy person can be trained for a flight into space. In this case, it is a professional journalist, but it could easily have been an astronomer, a biologist, a physicist, or a process engineer in his place. After all, it is clear that having professional scientists and representatives of industrial firms that will later use the fruits of the work in orbit for scientific and national economic goals makes far more sense than having cosmonaut-generalists. But for now, in our country only pilots and flight engineers are going aloft. And this vividly reflects the state of our manned space program, which for the present is working, essentially, for itself. Its real "return" is very small as compared, say, with what satellites give.

In one of the reports from the space launch facility a representative of the State Committee for Television and Radio Broadcasting abandoned himself to dreaming. Here, he says, the Japanese were able to send up their own cosmonaut just for the sake of the prestige of a firm, but will we be able to do so some day? Pardon me, but it has been precisely for prestige that we have been sending our own cosmonauts and foreign cosmonauts into orbit for almost 30 years.

Now we are sending foreigners for money. So let us finally use their money to learn a lesson for ourselves. The backup Japanese cosmonaut, the young woman journalist Rioko Kikuchi, convincingly demonstrated all the arbitrariness of our so-called thorough medical examinations. At Baykonur they performed an emergency appendectomy on her. True, it is difficult to get away from the feeling that that was done "according to script," for the dramatization of the situation and in order not to offend the better half of mankind, but that is only a conjecture, merely a theoretically possible version supported by no evidence. But if you rule that out, that means that our medicine simply "overlooked" an ordinary appendicitis.

But pardon a naive thought: inasmuch as the removal of the appendix, in essence, is mandatory for anyone who lives a long time, wouldn't it be better to perform this simple operation right away on those who intend to go aloft into space, without waiting for unpleasant surprises that are entirely possible? Let us imagine for a minute the "perforation" of an appendix in orbit! Medical personnel do not need to have, as they say, the wisdom of Solomon and 29 years of experience of manned flights to eliminate this quite realistic, not at all far-fetched danger. Or will we repeat the feat of the physician who cut out his own appendix in Antarctica?

Let us now ask ourselves: Of what importance are all the extensive examinations of the Soviet journalists who are candidates for a space flight that could possibly take place in July of next year?

I am a member of the space commission of the USSR Union of Journalists, and I assert in all responsibility that the commission did not have a real voice in the selection of candidates. Medical personnel decided everything via the principle "the younger, the better." As a result, six people were selected whose names, unlike that of Toyohiro Akiyama, are almost unknown to the public at large. They are just embarking on their journalistic path. And we do not yet know what we can expect from them. Effusive babbling about their star buddies and the Soviet space hardware that the "wings of socialism" put into space, or, on the other hand, sharp slander, which is so widespread in current young people's newspapers. Since there will not be a true public selection, it's most likely that the one to go into space will be one of the two chosen representatives of army journalism, who will be told exactly how to write and whom to glorify.

In any case, knowing something of the chosen candidates, I do not expect a mature interpretation of the present, very complicated situation surrounding our space program from the Soviet space journalist. And may the readers of IZVESTIYA forgive me for the lack of what many mistake for patriotism, but I am glad that a 48-year-old Japanese man, who has seen the world and is a professional international journalist, who managed to work in the United States, Great Britain, Vietnam, and the Philippines, became the first space reporter. I myself never aspired to participate in a space flight. But if I, as a member of the space commission of the USSR Union of Journalists, were given the real, not the mythical, right to choose between this 48-year-old Japanese professional and any of our six selected beginning journalists, I would give preference to him. That's my honest opinion, without any demagoguery about the prestige of our country, which in the fifth year of the great perestroyka is unable to feed its own citizens.

On this flight, for the first time ever, the life of a cosmonaut is insured. Toyohiro Akiyama told us at the space launch facility that during the entire period of his training at Zvezdnyy Gorodok, the TBS company paid him as if he were an ordinary correspondent accredited in Moscow.

"The space duty will probably be paid for in a special way," Toyohiro Akiyama said, thereby confirming that there was no agreement with the company on pay for the flight.

"True," he noted, "my life is insured for 300 million yen, but if that money is paid out, it won't be me who receives it."

But, fortunately, thus far there are no grounds for anxiety about the lives of the Japanese cosmonaut and his uninsured Soviet colleagues. When this issue was being prepared for press, the cosmonauts were about to open the transfer hatches of the Soyuz TM-11 craft and the Mir orbital complex. The principal stage of the international flight is beginning now.

Soviet-Japanese Flight Views as Example of Profitable International Space Cooperation

917Q0032 Moscow TRUD in Russian 11 Dec 90 p 2

[Article by TRUD special correspondent V. Golovachev, Flight Control Center: "Space and Money: Yesterday the Joint Soviet-Japanese Manned Flight Concluded"]

[Text] "This is simply splendid!" exclaimed the composed and restrained Japanese Prime Minister Toshiki Kaifu after the launch of the Soyuz TM-11 eight days ago. All last week, the Land of the Rising Sun, glued to television screens, followed the Soviet-Japanese flight. And yesterday morning, the flight ended safely. G. Manakov and G. Strekalov (130 days in orbit), along with Japanese journalist T. Akiyama (eight days aloft)

made a soft landing in Kazakhstan. V. Afanasyev and M Manarov took over the space watch aboard the Mir complex.

By ukases of the USSR President, the title of Hero of the Soviet Union was conferred upon G. M. Manakov, the Order of the October Revolution was awarded to twice Hero of the Soviet Union G. M. Strekalov, and Orders of Friendship of Peoples were awarded to the the Japanese cosmonauts—T. Akiyama and his backup, R. Kikuchi.

Japan became the twenty-second country with a representative to have made an orbital trip (in all 243 people have been in space). Space today is increasingly becoming an arena not of competition, but of cooperation and the consolidation of the efforts of various countries. This flight, the newspaper MAINICHI stressed, "opens an important page in the history of the development of space by Japan." Incidentally, the Japanese firm Mitsubishi Electric recently completed the assembly of a nearly 1.5-ton satellite for the study of the Earth's natural resources, the monitoring of the environment, early warning against natural disasters, and research in the interests of agriculture, forestry, and fishing. Here the Japanese do not intend to take decades to develop methods, but will strive to use the space data quickly with the maximum efficiency for the economy of the country. Recall that satellites now provide 80 percent of all the information from space, and the information is cheaper.

In that connection, the statement of cosmonaut A. Solovyev, who returned in August from the Mir station, comes to mind: "If I speak frankly, thus far in orbit we have also been performing work that could be painlessly abandoned in favor of experiments that are necessary for the national economy." We need to know how to count money. And the experience of the Japanese convinces us of that once again. Even for the present flight, which is more for prestige than enything else, experts believe that the money TBS has spent should be repaid with interest. On the Japanese side, nine major firms acted as sponsors of the expedition. The newspaper ASAHI reports that each of those companies paid about 500 million yen or even more just for the advertising placed on the hull of the Soyuz TM-11.

But what about the Soviet side? From an international expedition, it receives nowhere near that much foreign currency—a space ticket, as we have already written, costs $10-16 million, an amount that merely covers the costs of a joint flight. But aloft, foreign cosmonauts use our equipment and hardware. It would be logical for foreign partners to share, to some extent, their achievements in technology. That is important for the future. Agreements have already been concluded for citizens of Austria, England, France, and the FRG to go aloft on our craft, and that list, it seems, will be lengthened.

Meanwhile, in the United States a second [Japanese] astronaut is also training to be sent into space—Mamoru Mori, a 42-year-old physicist. In September 1992, he will go aloft aboard the American space shuttle.

As for the United States, more and more often one hears criticism there of the high costs of space programs. The latest report: as a result of major cuts in the NASA budget, it has been decided to change, for a third time, the design of the future orbital station Freedom. It will be smaller and will have more modest capabilities.

Orbital stations are now under development both in the United States and in the USSR (there the Freedom, here the Mir-2). It's very expensive business (for example, the initial cost of the Freedom program was $37 billion). Both we and the Americans are building space shuttles (our Energiya-Buran system cost 14 billion rubles). In the United States, programs are under study (in conjunction with other countries) for manned missions to the Moon and Mars (2011-2024) are being formulated, and the price tag for those programs is estimated to be an astronomical amount—$400 billion. But in the next 15 years the outlays of the United States for studies of the environment from space will come to, according to some estimates, $17 billion and, according to others, $39 billion. We are also conducting similar research, and a new Japanese satellite is also intended for that.

A simple idea suggests itself: Isn't such duplication in space research too expensive? Now that the inglorious "cold war" has ended, why not combine the efforts of not only the United States and the USSR, but also many other countries?

Comments on Soviet-Japanese Flight, Future Commercial Flights, Buran Plans

917Q0033

[Article by M. Rebrov: "Report From the Flight Control Center"]

[Text] The Soyuz TM-11, which is docked to the Mir station, is circling above the planet. The dream of the Japanese cosmonaut-journalist to see Earth from the heights of space orbit and to see the stars, from which the cloudy veil of our atmosphere has been lifted, has already come true. Back before the launch, Toyohiro Akiyama expressed his admiration for his fellow crew members and, as he said, for their "great professionalism and great humanity."

To the many unusual things about this voyage, another was added: the American Shuttle was launched almost at the same time as our Soyuz. Today, 12 envoys of Earth are in space. The cosmonauts and the astronauts intend to establish a radio link between the two craft. I believe that the "Derbents" and "Vulkans" will take part in those conversations.

The flight program for our Buran has already been specified. Its launch is intended for the second half of next year. It will leave Earth unmanned and will dock in automatic mode with the Mir station, to which it will

deliver a special module. The cosmonauts working at the station will visit the winged craft and will perform a number of work operations. Then its linkup with a Soyuz-type craft and the execution of a completely new program, which is called "rescue in space," are envisaged. After that, the Buran in automatic mode will land at Baykonur or in some other region that is adapted to handle shuttle spacecraft.

But that is tomorrow. Just as is the commercial program that is planned for 1991 and 1992. I'm speaking of the flights of international crews that will include cosmonauts from England, Austria, the FRG, and France. "We have 19 commercial agreements, 10 of which are being implemented to one degree or another," journalists were told by A. Dunayev, chief of USSR Glavkosmos.

The hookup is a fairly long one, but, as they say, the sun hasn't gone down yet. Owing to its six mooring "berths," our Mir is capable of building up its "geometry" and weight. When the "star-shaped" configuration is fully implemented, the station, through such expansion, will have acquired a weight of 180 tons, a length of 33 meters, and only a slightly smaller width. The working staff of that scientific, production, and testing base in space will, of course, also increase.

A small Japanese doll—a gift of the Land of the Rising Sun to our first cosmonaut, Yuriy Gagarin—floats in weightlessness. The "Derbents" brought that symbol with them on the flight. Rioko Kikuchi looks with slightly sad eyes at the television screen of the Control Center. She wants so much to be there, in orbit, even if only as that doll, but....

"Why did the TBS company decide to address the proposal for this flight to the USSR, and not to the United States?" The response of the Japanese was as follows: "There are several reasons here. First, the Americans do not make agreements with private firms. Second, they have had several accidents. The Soviet hardware, on the other hand, operates reliably."

In the end it is the right of the Japanese to choose a partner for themselves. But we can't help but think that the agreement on the present joint space flight will provide a new stimulus for the development of the scientific, technical, and economic ties of our countries.

A stimulus.... The docking is completed between the Soyuz TM-11 and the Mir station. And that's where the primary work of the international crew has begun—aboard our complex. We wish success to everyone who is working in orbit!

Training at Zvezdnyy for Candidates for Journalist-Cosmonaut Flight

917Q0011 Kiev KOMSOMOLSKOYE ZNAMYA in Russian 21 Oct 90 pp 8-9

[Article by Vadim Dolganov, KOMSOMOLSKOYE ZNAMYA parliamentary correspondent, Cosmonaut Training Center, Zvezdnyy Gorodok, under the rubric "From a Journalist's Notebook": "Not by Bread Alone: Or Our Man at Zvezdnyy"; first paragraph is source introduction]

[Text] *As already reported, the training of journalist-candidates for flight aboard the Soyuz-TM spacecraft has begun. Among the six lucky fellows is Yuriy Krikun, from Kiev. He represents KOMSOMOLSKOYE ZNAMYA and the Dinamo club (Kiev). The details from Zvezdnyy Gorodok are being sent by a special KOMSOMOLSKOYE ZNAMYA correspondent.*

Today our space programs, like everything else, are coming under criticism. Even such questions as "Why?" and "For what purpose?" are being asked. Why should we invest billions in the development of space research when not even the most basic foods are in the shops? What's the purpose of sending a journalist into space? Truthfully speaking, I too have mixed feelings on the subject. On the one hand, I thoroughly understand that right now sausage is more important than a new launch. But, on the other hand, well, it would be worth it ot give some thought to the other side of the coin. Space, perhaps, is the only sector of our economy (apart from armaments) where we have some kind of preeminence. And even if we cast aside all the noisy bravado of officious propaganda that "we are No. 1 in the world," the picture is not as gloomy and depressing as it is, for example, in automobile manufacturing or light industry. The feats that have been performed by our crews in orbit constitute a "golden horde" for our country, "know-how" that can be sold for a profit or that we can use ourselves. It is a great pity that we have not yet learned how to conduct trade in our space achievements. And the reason, I think, is not a lack of "space businessmen," but the situation that everything associated with rocket technology got into. It was kept secret from the people, from the press. It was more difficult to hide things from "them." That's not what I say—that's what Vladimir Afanasyevich Lyakhov, twice Hero of the Soviet Union, said. He explained that the Americans know everything (or virtually everything) about "our space program." That's not so difficult to do, what with today's level of technology. All the radio conversations of the crews of Soviet craft are recorded. And from other sources at Cape Canaveral they learn what is going on at Baykonur, at Kapustin Yar, or at Zvezdnyy. But the commercialization of space is another matter. I would like to lay it aside for the time being (if, of course, I can). Let's talk about something else. From TASS reports and TV programs we learned about the victories and, very rarely, about the failures. And then we're astonished: why is the entire cosmonaut corps being awarded Gold Stars? We realize that a simple and clear thought, one that's comprehensible to every schoolchild in the West, has been removed entirely from our awareness: the profession of cosmonaut is the most dangerous of all the professions. And now, as we make our way through the jumble of information and disinformation, as we carefully read the lines and chapters of books on space, we have to think a

little about the paths taken by research in the past and what the future holds. There is no doubt that many years from now, people studying the history of today will not be asking the question, Was it or was it not a good thing that we interrupted space research during the period of perestroyka and economic crisis? To interrupt such research is the same as cutting off the wings of a bird or sending a nightingale to the meat factory. Accordingly, most of my colleagues have an optimistic attitude with respect to the forthcoming flight of a journalist. And no matter what anyone says, our journalistic profession looks at many things in a special way. And what may slip the attention of an Air Force colonel, a journalist may catch.

That's why there was great interest in the presentation of the new group of candidates. A whole detachment of press writers, photographers and radio-TV reporters hustled to the press conference at Zvezdnyy Gorodok. On the other side of the table was also a very decorous group. Vladimir Shatalov, chief of the Cosmonaut Training Center imeni Yu. A. Gagarin; Aleksey Leonov, his deputy; Vladimir Lyakhov; Valeriy Rozhdestvenskiy; Vladimir Titov; Aleksandr Volkov. Those last names are household words. And then there were many of the people who, remaining in the background, had helped them get to where they are. The heads of the medical, aviation, navigation, and athletic training faculties—those to whom most Soviet cosmonauts owed their excellent launches. My neighbor on the right, a gray-haired colonel, said, "Never before has the 'entire flower' of the Cosmonaut Training Center been gathered together for a presentation."

That means that they are interested in our brother. It means that they, too, are interested in the flight of a journalist.

The first to speak was Shatalov: "The medical commission and the rigorous screening are behind us. The names have been announced of the six who have been invited to live and work at Zvezdnyy Gorodok, to train for a launch.

"Here is the schedule for the flight of the spacecraft," he continued. "From launch to entry into orbit, to docking, to undocking, to touchdown. And not one of the veterans could name you even one point in the schedule where we could not stumble. We've discussed some, others we haven't. There's almost never been a flight in which no unplanned situations came up. Hence the need for serious flight preparations. I was a little surprised at the ease, even the nonchalance displayed when there was first talk of flight of a journalist. We figure that you, after having undergone training, not only will be ready for any emergencies in flight, but will also sense the full complexity of the space organization, its interrelationships and the special nature of preparation for experiments in orbit. So that you'll get a more detailed grasp on what makes up space programs. Why is there no adequate scientific payoff? Why in certain cases we don't get the results we had counted on? So that by your presence you will give a new impetus to the development of Soviet cosmonautics."

Aleksey Leonov spoke in greater detail about the training of the candidates:

"We decided that the flight training of the journalists would extend over one-one and a half years. That is a half-year less than it took under our traditional program. Beginning today, you will be busy with disciplines such as medical research and physical training—an individual program will be drawn up for each candidate, depending on his condition—plus training in motion picture and still photography and television reporting. The latter discipline assumes that at the end there will be an examination on composition, choice of television topics, and photography, to which we will invite your colleagues so they will also see what you have learned here. It is obvious that we also can learn something from you. This should be interesting, creative work. You will study the piloting of a space vehicle, control systems, space navigation principles, computer principles and space medicine. At the end, examinations by an expanded group of specialists will be held on all those subjects. In the commission we will include not only those who work at the Cosmonaut Training Center, but also representatives of equipment-manufacturing enterprises and scientific researcher specialists. But there is far more. Before any of you go up into space, you must study the design of systems on the Soyuz-TM craft and the special features of the modules—the astrophysical, resupply and production modules. That is basic equipment on which you will work for a long, long time. During the training, we will employ interesting and diverse equipment. For example, we have a TU-154 aircraft with unique 700 x 800 mm windows. The aircraft is outfitted for exercises in visual astrophysical research. You will use the unique TF-6 camera. We also plan to carry out flight and parachute training exercises with you—a study of equipment and also practical work, i.e., flights and jumps. We also have specially outfitted aircraft for creating artificial weightlessness. You will be able to "fly" in them for 20-30 seconds. We will take you into the tundra at a temperature 45-50 degrees below freezing and into the desert where it is 40-50 degrees above. And only the two who remain as part of the crew after undergoing general space training will be included in the makeup of the crews and will begin prelaunch training.

"The graduation examinations are planned for February 1992, and the two who are deemed the best will begin work as crew members."

The journalists asked the organizers of the forthcoming expedition many questions. "Why are there six persons in the group of journalists?" we asked of the writer and journalist Vladimir Gubarev.

"The training of the first six Soviet cosmonauts began exactly 30 years ago."

There were questions to Vladimir Shatalov:

"There has been talk of a manned flight lasting one-one and a half years. Will there be such a launch?"

"I've heard that talk. Like someone even gave a promise to someone. I don't know who that was or to whom such a promise was made. If the talk is about the Martian program, that's one thing. But in near-Earth orbit, we need to get an economic return from what has already been worked out and put in place. I'm also talking about in-orbit production of various materials for industrial needs."

"How many new cosmonaut candidates are now undergoing training at the Center?"

"Besides those you already know about, three other fliers are being trained. In addition, work is continuing on the training of British astronauts. And also three Buran test pilots. They have already started to work."

"The economic return from space programs has been minimal so far. Why?"

"That is beyond our control. Photographs taken in 1975 lie around unprocessed; the advanced technology of Buran and Energiya is not being put to extensive use."

"So, is it worth it under such conditions to also send a journalist into space?" The question was addressed to V. Gubarev. "Will our colleagues, by means of ads or any other actions, pay back what is invested in their training on the ground?" "We wabt to use this flight as an example of how it is possible to earn money. But not just from ads. We want to draw the public's attention to this flight in the 'Space—for the Children' program. We will return the 10 million that the flight of a journalist will cost. As the ancients said, men differ from swine in that sometimes they raise their eyes and look at the stars. It is therefore immoral to talk about how much it has cost."

At that point, noise began in the hall. The "noncandidate" journalists were indignant at the last remarks of their PRAVDA colleague. Even Shatalov had to intervene: "We gathered here on a solemn occasion. And you are beginning a trade-and-commerce conference," he noted reproachfully.

But the tide had already turned. And captious questions rained in the direction of the hosts.

"So all this looks fine. But the functions of the journalist aboard a spacecraft are unclear. What is he—a reporter, a researcher? Or maybe just a passenger? In which case, a ticket costing 10 million rubles is a but expensive."

"For the time being," Shatalov said, "there is no final work program for a journalist. But we hope that it will be worked out with your assistance."

Economic themes and problems loom so large over our society, over all of us, that they suddenly became the most important issues at the press conference at Zvezdnyy Gorodok. Everyone was interested in "cash" issues associated with more than just "intraunion" trips. A question was asked, for example, about the joint Soviet-British flight. It is known that decisions have yet to be made on how the financial costs will be shared. It's certainly not for purposes of philanthropy that dozens (and possibly hundreds?) of Center specialists are training the British. At that point, Shatalov reached "the boiling point."

"They regularly pay us for transport, board and so forth. At this time they owe nothing to the Center. And outside of that, the matter does not concern us. Leave that to the Ministry of Finance. We have other obligations—training the candidates for launch. And if they pass the course successfully, we recommend them for flight. And how financial negotiations will go between Glavkosmos and the Energiya Scientific Production Association is another matter. And in exactly the same way I am not interested in the financial part of the program for the training of a journalist. That is not part of my job."

But let's return to our man in Zvezdnyy. Yuriy Krikun now has enough sponsors. Business firms as well as the Kiev Dinamo club. But (and this was conspicuous) the presence of "his own" correspondent at the press conference in Zvezdnyy, the first in his life, delighted the lad. And as soon as the TV sophists fell quiet, I asked Yuriy several questions.

"Are you already settled in at Zvezdnyy, and have you adapted yourself to your surroundings?"

"In general, I have settled in. A very nice apartment in the preventorium where the crews live who are already training for flight. A two-room apartment with all the conveniences and a view of a lovely lake."

"What have you been able to see during the first days of life here?"

"We have been introduced to the cosmonaut detachment and our commander Aleksandr Volkov. And we immediately began our exercises. The first two instructions were about craft systems. Then a medical examination and physical training."

"On the lapel of your jacket is a Kiev Dinamo 'label'. Is that advertisement for the club?"

"Yes, the soccer club is one of the sponsors of the 'Space—for the Children' program. In addition, on my shirts are ads for Sovuniti, a firm of Ukrainian producers of advanced technologies. It is also a sponsor."

"Do you receive anything for that advertisement?"

"For the most part, the proceeds go to the program. The profits from the advertisement will be used for the purchase of pure medical products from abroad for the children of Chernobyl and other regions of the Ukraine and Belorussia that were stricken by the catastrophe."

"How do you feel about the discussions at the press conference concerning the financial aspects of your flight?"

"We have developed a clear-cut program. We are sure that this flight will pay for itself approximately a hundredfold. "

"How, for example?"

"There will be an eight-day marathon. The appropriate contracts have been signed with a number of leading television companies. Including Ted Turner's. There will be television bridges between various countries and continents, all kinds of lectures by scientists, a competition, a service for acquainting people with space. We are also planning a number of other activities, including a soccer match between the Dinamo (Kiev) team and the American Cosmos team."

"After the first day of training, how do you rate your chances for flight?"

"I have faith. I think that everyone believes in his own success."

"And if it doesn't turn out that way?"

"A journalist should come here in order to check himself out in extreme situations. Because our profession is a state of the heart. That means that we shouldn't pass up a unique chance to test ourselves in an unusual role."

"Are you thinking about writing a book about your work here?"

"That's hard to say at the moment. Although I am thinking about it."

Yura hurried off to a lecture. But I had a chance to look around Zvezdnyy, without hurrying, and with my camera. Vladimir Afanasyevich Lyakhov himself, a meticulous and thorough man, served as the tour guide.

The theme of "Space and the Press," as it were, hung in the air. And our stroll through the "domains" of Lyakhov—now deputy chief of administration at the Cosmonaut Training Center and in charge of all the simulators and technical equipment—also began with a conversation on that subject. To be even more precise, with some barbs. Lyakhov recalled his long-held resentment of Central Television. In a joint flight with an Afghani cosmonaut, the two almost perished; they spent 29 extra hours in the reentry module (getting ahead of myself, I can't help but mention how, later, Lyakhov, with some satisfaction, shoved me into that small sphere, closed the door, and, with a smile, said, "Sit in there for a while and imagine what it would be like to lounge around for more than 24 hours"), and almost as soon as they landed, there was an interview. The first question was naturally about how it had happened, what had malfunctioned. Dead tired, his nerves frayed from the ordeal in orbit, Lyakhov began to think out loud:

"Maybe the equipment failed. Maybe something with the navigation instruments. Maybe I made a mistake. We still have to make a careful study of everything."

In the evening, the "Vremya" TV program went on the air, and the first part of what he had said was "edited out." So it looked as if Lyakhov was blaming himself for everything and needed to take a close look at himself.

"Why judge the entire press on the basis of the 'Vremya' program?" I parried. "I myself don't care much for 'Vremya', they lie a lot and leave things unsaid. I've run into that in the course of actual events."

"All of you lie. There have been fanfares in our direction when a little criticism was deserved. Then you jump on us, pounce on us, as if you were generally trying to break up the Training Center."

He was, of course, exaggerating. But the topic is a serious one. It hits you in the face at Zvezdnyy. For example, the Mir station has been painted to us as an earthly (or space?) paradise. And now I had a chance to go aboard it. It was astonishing to me how people could spend a year inside it! A multitude of inconveniences. And although everything was done painstakingly, it was without adequate comfort and decor. You know, it's the same as if a Mercedes had been put together by hand by the experts from some "Rivet It Yourself" cooperative. Never mind the reentry modules and transport craft. And the production standards themselves for that equipment were inadequate, as were cosiness and comfort.

Cosmonauts encounter a great many problems, not to mention extraordinary situations. Just from what Lyakhov was able to tell in a couple hours, you could easily write five or six harrowing tales. About how he mended a spacesuit in orbit so he could do an EVA in it. And how he did emergency work outside in order to save the station.

I have not had the opportunity to be in Zvezdnyy Gorodok in the last three years. The changes that have been made were apparent: the signs with clamorous slogans and challenges had been removed, and there was less ostentation. But the charm of Zvezdnyy had faded a bit. Not so smart in appearance. In the little kiosk located on the first floor of the Museum of Cosmonautics, you can't even purchase a souvenir badge. It wasn't so long ago, after all, that the shelves were sagging beneath all kinds of souvenir medals, badges and booklets. But now they offer you only a very modest publication with photographs of the museum exhibit, and not at a modest price.

Ah, how vexing it is that for us everything is reduced to store shelves! But they are an indicator. At the Zvezdnyy commercial center, where recently all kinds of shortages prevailed for months, at least the ball is rolling. Food and clothing are now distributed by lists. And cigarettes in precisely the same way...

An unpleasant autumn rain slashed against the flagstones of Zvezdnyy. In a distant auditorium, Yuriy Krikun was hunched over a synopsis. A throng of young Zvezdnyy boys chased a ball on the sports field, not even paying attention to the weather. And past a massive

monument to the first cosmonaut, a weary, no longer young woman, clenching an umbrella and a shopping bag in one hand and holding a little grandchild with the other, slowly made her way to the commercial center. It was Valentina Gagarin, the wife of the very lad who was the first to go aloft.

Details of 'Soyuz-9' Mission Recalled

917Q0014A Moscow SOVETSKAYA KULTURA in Russian 14 Jul 90 p 15

[Article by L. N. Kamanin: "Removing the Cosmetic Retouching: N. Kamanin—From his Journal Entries for 1970"]

[Text] **Unfortunately, the "cosmetic retouching" has not been removed from many pages of our homeland's space program up to the present time. One such page is the 17-day flight of Andriyan Nikolayev and Vitaliy Sevastyanov in the Soyuz-9 space ship, which made a safe landing on 19 June, 1970. This flight became a portentous event in the development of the Soviet space program, having laid the foundation for routine prolonged cosmonaut missions into near-earth orbits. In our time, such missions are perceived by the general public as an almost commonplace phenomenon, but the first prolonged manned flight in space, to a large extent, was a flight into the unknown.**

21 May

Two days ago, the cosmodrome welcomed us with heat and a cloudless sky, but after just a day, the weather worsened appreciably—a rather dense cloud cover appeared and the wind grew sharply stronger. Yesterday, when a routine Zenit was launched from the launch pad intended for the Soyuz-9, the gusts of wind reached up to 20 and more meters per second. The rocket inserted the Zenit into orbit normally, but, during the takeoff, slightly covered the launch trusses and cables with its "fiery tail." The cosmodrome's specialists carefully examined all the damage and assured us that they will eliminate it prior to bringing out the Soyuz-9 for its launch.

22 May

Today, it was clarified once and for all that the launch of the Soyuz-9 on 31 May will not take place. During the integrated testing of the ship, detected in its electrical system were intermittent currents, the source of which had still not been determined. Instead of the standard 38 volts, numerous measurements indicated more than 60 volts. It is still necessary to test the Soyuz-9 in the pressure chamber, to fuel it up and to mate it with the rocket and then to make an integrated check of the ship and the rocket.

Mishin is still not at the cosmodrome—he is directing the technical preparations for the launch from Moscow. The results of such "direction" are evident: the ship and the rocket should have been ready for launching back in early April, but the launch will not even be at the end of May. Of the 20 members of the state commission, only Kerimov, Vorobyev and I are at the cosmodrome. The attitude toward the preparations for the prolonged space flight, beginning with the highest leaders and ending with the rank-and-file workers, is most nonchalant. Under Korolev, there was never anything like it—Sergey Pavlovich was always one of the first to arrive at the cosmodrome and personally directed the preparing of the ships and the rockets for a flight, all the members of the state commission also arrived in good time and all the cosmodrome's personnel worked with a great deal of interest and total efficiency.

25 May

Today, all the crews were busy with the prelaunch preparations at pad 31. Nikolayev and Sevastyanov were engaged in aligning the seats, testing the supports and adjusting the restraining straps. Then the doctors conducted lessons in adjusting the belts with the sensors and reminded the cosmonauts of the rules for recording physiological functions.

When we flew to Tyura-Tam a week ago and settled in at pad 17, all the officers were told that smoking within the premises of the cosmodrome was explicitly prohibited. This implied in itself that the cosmonauts do not smoke and that, for them, even tobacco smoke is harmful and unpleasant. Yet, just this evening, quite by accident, I discovered that, in the room adjacent to mine, Nikolayev and Sevastyanov, the primary crew members of the Soyuz-9, were smoking. I also knew previously that Nikolayev was sometimes not adverse to "indulging in tobacco": in December of last year, I myself personally saw him with a cigarette in his mouth. At that time, I had a very serious conversation with him, after which he gave his word that "this will never again be repeated." I believed Nikolayev, but he did not keep his word. I do not even know which is more unpleasant—the fact of the deception itself or the gross violation of the policy a few days prior to the launch.

26 May

For the first time in our ten-year acquaintance, it was unpleasant for me to talk with Andriyan Nikolayev. It is true, he did not begin to deny it and confessed straight out that Sevastyanov and he had been smoking yesterday. Nikolayev also confessed to the fact that this was not the sole instance of smoking. If I had learned of this a month ago, I would have been against allowing Nikolayev and Sevastyanov to fly, but now, when there are only a few days left until the launch, and Nikolayev's crew had already been confirmed in fact as the primary crew in the party's Central Committee and the government, it impossible to raise the matter of replacing the cosmonauts with their backups. It is necessary to take the strictest measures to ensure that nothing similar will ever happen again and to preclude completely the possibility of smoking on board the Soyuz-9. Many people, even my closest assistants and the doctors, do not understand all the dangers of smoking by the cosmonauts. It is not just

the fact that cosmonauts not out of the habit of smoking will have a harder time during a prolonged flight. The main danger is that they might take tobacco on the flight and smoking in the ship's atmosphere, which is supersaturated with oxygen, might cause a fire and the inevitable death of the crew.

Feeling their own guilt, Nikolayev and Sevastyanov are walking around crestfallen and Andriyan is especially taking our unpleasant conversation to heart. I am certain that they both will draw the correct conclusions from the smoking incident. Tomorrow, it will be necessary to cheer them up a little.

29 May

In the morning, General Pushkin flew to Karaganda to check the readiness of the Air Force's search craft, while General Ponomarev rode with a group of officers to pads two and 31 to familiarize themselves with the final operations on preparing the ship. All the cosmonauts and I remained the entire day at pad 17. The doctors conducted the final examinations of the crews' members. According to the preliminary data, everything is fine with the cosmonauts' health.

In the middle of the day, a telegram arrived from Moscow from General Goreglyad, in which he reported that the enterprise which produces cheese for the cosmonauts withdrew its guarantee of suitableness for its own product. It was necessary to get in touch quickly with Deputy Health Minister A.I. Burnazyan, who is responsible for the quality of the food supplies on board the space ship, and ask him, along with the minister of the food industry, to confirm the high quality of all the remaining products which will be stored on board the Soyuz-9 tomorrow. After three hours, we received such confirmation and the only thing left to do was to replace the cheese in the ship's rations with something else and... to punish the culprits severely. The latter matter was handled by the chairman of the state commission, while the cosmonauts and I quickly agreed with the doctors to replacing the cheese with various canned meats.

31 May

Tomorrow morning, the rocket, mated with the ship, will be set up at the launch site. The Soyuz-9's launch is supposed to take place on 1 June exactly at midnight, local time.

In the evening, a "pro forma" meeting of the state commission was held. Andriyan Nikolayev was confirmed as the Soyuz-9 commander and Vitaliy Sevastyanov as the flight engineer. The crew thanked the commission for their high confidence and assured them they would carry out the task completely. Then Nikolayev and Sevastyanov participated in a press conference for television. The press conference went poorly and both the cosmonauts and the correspondents felt constrained: and both groups knew that it was forbidden to talk about the main feature of the upcoming flight—the duration of the stay in space, but no one wanted to repeat the truths known to everyone.

1 June

At 7 am, it is quiet in the hotel and the cosmonauts are sleeping. Reveille has been set for 10:00 am (yesterday, or more accurately, today, because of soccer, everybody went to sleep after 2 am), but I woke up several minutes ago and cannot sleep any more. Today is the launching of a very complicated and prolonged flight. The weather forecast for launch time is good—clear, temperature around 20 degrees and a wind of no more than 5 meters per second. The flight, in all respects, has been prepared quite well and I have a firm conviction that the launch will proceed normally.

...At 11:00 am, in my presence, the doctors woke Nikolayev and Sevastyanov up (when we entered the room, both of them were sleeping soundly). In response to my question about how they had slept, both cosmonauts stated in one voice: "Fine, but it would have been nice to sleep a little longer."

...At 2 pm, a meeting was held of the group of generals and officers of the Air Force on ensuring the safety of the Soyuz-9's crew during the launch. They defined more precisely the tasks and the daily routine and they paid special attention to the readiness of the search service and the emergency crew at the launch site. Then, in the presence of Shatalov, I told Nikolayev and Sevastyanov that they are explicitly forbidden to request from space an extension of the flight beyond the planned program.

...At 9:45 pm, the Soyuz-9's crew arrived at the launch pad, where, by this time, all the members of the state commission had assembled. Nikolayev reported briefly and very calmly about their readiness for the flight. About five minutes later, the cosmonauts had already taken their seats in the ship and set about checking communications, equipment and the cabin's conditions.

The launch was carried out exactly at midnight. The radio communications and television worked splendidly. Shatalov, Filipchenko and I talked with Nikolayev and Sevastyanov right up to the Soyuz-9's entry into orbit.

3 June

I woke up, as usual, at 7 am. There had been no call from the KP (command center), so that means that everything is normal on board the Soyuz-9. Outside, it is a gloomy morning and a fine drizzle is falling. After a momentary hesitation, all the same, I went out for my morning run. In total solitude and not without effort, I ran along the field path about a kilometer—the soaked black earth stuck to my sneakers and my feet slipped and slid around. Yet, all the same, to run through the middle of the boundless wheat field to the unceasing song of the larks was so pleasant that I pitied our young sleepyhead officers who are robbing themselves of their health.

At 10:00 am, a meeting began of the operations and technical supervisors. Specialists from all the services reported on the normal progress of the flight. However, a more thorough analysis of the flight data indicated that there are errors in the crew's work with respect to the times for the firing and cutoff of the attitude control engines. It is true, it may turn out that these are not even errors at all, but rather, reasonable crew corrections to the flight program. We have already had to contend with the need for program correction. It turned out that nearly 50 minutes are needed to perform the complete set of physical exercises under space flight conditions, whereas the cosmonauts managed this in half an hour on the ground. The doctors and the cosmonauts themselves still need to do a bit of thinking in order to come up with the best solution to the problem of adaptation to weightlessness.

Late in the evening, we watched the Soyuz-9's crew on television—Nikolayev and Sevastyanov made a routine report from orbit. Judging by all appearances, for the time being, they are maintaining a high degree of working efficiency, but Sevastyanov's face seemed to be a bit swollen to me. I assigned the doctors the task of monitoring carefully Sokol-2's state of health.

4 June

Today, Afanasyev, Mishin, Kerimov and Karas flew off to Moscow. I stayed behind in place of the chairman of the state commission and the flight director. Tregub stayed behind in Mishin's place.

During the second half of the day, there were many worries because of failures in the solar array (SB) control system. During all the preceding Soyuz flights, we carefully monitored the current of the solar arrays which recharge the buffer storage batteries and there were moments when the recharging current turned out to be inadequate and the crews had to conserve electric power. During the Soyuz-9's flight, a new trend appeared: an increase in the storage batteries' recharging current, caused by the intermittent operation of the solar arrays' automatic equipment. Today, on the 47th orbital revolution, Sevastyanov reported: "The solar arrays have been turned off, but the current is 26 amperes." This shows that the solar array control switch is defective. For two days of the flight, the crew had to turn off the solar arrays manually more than 12 times. The number of times they can be turned on and off manually is limited to 15 (during these operations, a hazardous level of hydrogen accumulates in the instrument compartment), thus, with such operating conditions, the flight will have to end on the eighth day... On the flight's 48th orbital revolution, we assigned to Nikolayev the task of noting accurately the time of sunset and sunrise. It turned out that "night" lasted all of 40 seconds for the cosmonauts. During the last Soyuz flights in October of 1969, the space nights were measured in dozens of minutes, but now, in June, on practically all of the Soyuz-9's orbital revolutions, they do not exceed a single minute, since the ship's orbit is nearly parallel with the terminator. Under the conditions of the "white nights," the solar arrays are generating a nearly continuous electric current—a surplus of electric power is being accumulated on board the ship.

In view of the situation which had arisen, the crew was given the instruction: "During the sleep period, put the ship into an axial spin at a rate of 0.5 degree per second." With such a "turning away from the sun," the solar arrays should not generate a current, yet it will not cause any unpleasant sensations for the resting cosmonauts.

5 June

All our worries have abated. Judging by the crew's reports, the solar arrays are now operating normally: after a routine "turning away from the sun," the voltage in the electric system increased up to 31 volts, while the current strength increased up to 26 amperes. This means one of two things: either the defect in the solar arrays' switch corrected itself (and such things do happen) or Sevastyanov, in reporting yesterday about the solar arrays' operation, mixed up the readings for the voltmeter and the ammeter, which is quite possible since they are installed in a single instrument.

7 June

In the evening, a routine meeting of the landing commission was held. They listened to the reports of the meteorologist, the ballistician and the doctor. The most interesting one was the report by Colonel Lebedev of the Medical Service.

Over the six days of the flight, we have obtained a lot of valuable data on the effect of prolonged weightlessness on the crew's state of health and working efficiency. The overall opinion boils down to the fact that the cosmonauts feel significantly better on the sixth day than on the first two-three days of the flight. After studying carefully once again all the cabin conditions and the medical indicators of the crew's condition, we decided not to make any changes in the flight procedures for the time being. The overall conclusion is: everything is in order on board the ship and there are no comments. In such a reassuring situation, certain hotheads began to talk about an extension of the Soyuz-9's flight to 20 days. A meeting was held specifically on this matter with the Air Force officers and an order was given to stop needless conversations and to analyze carefully the data on the condition of the cosmonauts and the ship, keeping in mind that the flight's main difficulties are still ahead.

10 June

Yesterday, from 9 pm to midnight, I carefully listened to all the radio traffic with the crew and watched the cosmonauts on the television. Everything seems to indicate that Andriyan and Vitaliy feel fine. It is true that I am concerned about the reduced consumption of drinking water (one liter per person per day) and oxygen (around 17 liters) by the crew. This is evident proof of the cosmonauts' insufficient mobility.

Today, we granted the Soyuz-9's crew their first day off, called off all the experiments and limited the radio traffic to a minimum. Nikolayev and Sevastyanov readily responded to my suggestion to play a game of "Space-Earth" chess. The space chess match, in which the ground team was represented by Cosmonaut Gorbatko and myself, went on for three orbital revolutions and ended in a draw.

All the ship's systems are operating normally, but, because of the low expenditure of oxygen, an increase in the "atmospheric" pressure in the cabin is being observed—at 2 pm, Sevastyanov reported that it had increased to 900 millimeters, that is, almost to the highest tolerable level. We recommended that the crew attempt to reduce the pressure by lowering the temperature. The recommendation turned out to be helpful: by 10 pm, with the temperatured lowered from 21 to 18 degrees, the pressure decreased to 870 millimeters.

11 June

At 6 am, Colonel Gorbatko reported from the command center: "Everything is in order on board the Soyuz-9. The crew is sleeping. The flight's 151st orbital revolution is winding up."

I talked several times with Nikolayev and Sevastyanov, carefully examined them on television and studied the materials of the radio conversations. I should confirm once more that the 10 days of the stay in orbit did not exert any noticeable influence on the cosmonauts' state of health and working efficiency. The doctors are also still not noticing any kinds of changes in the crew's condition. Yet, all the same, I am thoroughly convinced that the flight should not continue beyond 17 days.

Today, I had a serious talk with Bykovskiy and Gorbatko—they both smoke. Gorbatko promised to stop smoking immediately, but Bykovskiy, after acknowledging that he systematically smokes four-five cigarettes a day, did not make such a promise. I warned Bykovskiy that he would no longer be able to go into space if he did not give up smoking. So, four cosmonauts (Nikolayev, Sevastyanov, Gorbatko and Bykovskiy) smoke and General Kuznetsov, the head of the TsPK (Cosmonaut Training Center), does not even suspect this. It will be necessary to put strong pressure on the smokers once again.

13 June

On the 12th day of the flight, the crew displayed noticeable signs of fatigue and a decrease in working efficiency—errors in working with the equipment, slips of the tongue and repetitions in the radio traffic. Externally, Nikolayev and Sevastyanov look somewhat puffy and listlessness and irritability can be sensed in their actions. After talking things over with the cosmonauts, we decided to shorten significantly for the subsequent days of the flight the volume of experiments and to increase the rest periods.

15 June

Today's first communications session with the cosmonauts began with worries—for nearly three minutes, the cosmonauts did not respond to our calls. It was necessary to turn on the "Reveille" signal. Sevastyanov answered first and Nikolayev right after him—both apologized for sleeping through the time for beginning communications (we had given them more than nine hours for resting). As he woke up, Sevastyanov, in turning on the cabin light, erroneously pushed the button for turning on the ASP (Automatic Landing System) display, which is supposed to light up after the separation of the ship's sections on a signal from the pressure relay at an altitude of 11 kilometers. No provision had been made for turning off the display from the console and now it will burn until the landing itself, getting on the cosmonauts' nerves. In addition, now the automatic landing system will be alive for several days, which had also not been foreseen and does not preclude the emergence of failures in it, although Tregub and the specialists do not seen anything dangerous in this situation. During the flight of Filipchenko's crew on the Soyuz-7, there had already been a similar instance of the erroneous activation of the ASP a day prior to the landing. At that time, we had asked Mishin to provide an interlock for the ASP button and half a year has passed, but the control panel defect has not been eliminated.

16 June

Everything is normal on board the Soyuz-9, if you do not count the fact that one of the local commutators of the telemetry system designed by Ryazanskiy failed. Now we will not have telemetry data for a number of important parameters on the flight and on the operation of the ship's equipment. The cause of the failure is still not clear and this is causing some anxiety, although Mishin and Ryazanskiy believe that the flight can continue.

At an expanded meeting of the operations and technical supervisors, with the state commission members participating in it, we listened to the specialists' reports on the results of the Soyuz-9's two-week flight. The general conclusion from all the reports is: the flight may be continued until the total completion of the set program. At the end of the meeting, Mishin put a question to the ballisticians about the ship's orbital parameters on the flight's 20th day. Blatantly visible behind this question was Mishin's intention to extend the cosmonauts' stay in orbit to 20 days, but I deliberately did not begin to talk with either Mishin or Kerimov about the date of the landing. At lunch, Mishin did not hold back and asked me, am I of a mind to fight? Knowing what he was driving at, I responded that, for the time being, I see no reasons for shortening the flight program. I did not begin to talk about the fact that the members of the landing commission from industry—Severin, Tkachev and Darevskiy—had urgently requested that I not permit an increase in the duration of the Soyuz-9's flight beyond the program.

Yesterday, during talks with Mishin, Nikolayev mentioned the two-day "reserve" of provisions on board the ship. I decided to check, did he not have in mind the NZ—the emergency rations? From Andriyan's muddled explanations, I understood that, in addition to the two "standard" rations, the crew still had another 10 cans of food and some bread, which is significantly less than one day's ration. Nikolayev did not dare to tell me that the NZ is the "reserve, but I was finally convinced that Mishin's attempt to stretch the flight to 20 days is sheer adventurism.

At a meeting in a narrow circle (Mishin, Kerimov, Chertok, Tregub, Vorobyev, Agadzhanov and myself), Mishin attempted to get a decision on extending the flight beyond the program. Vorobyev and I spoke out against Mishin's groundless suggestion and Chertok, Agadzhanov and Tregub supported us. After finding himself in the minority, Mishin turned on Vorobyev, accusing him of not providing the Soyuz-9's crew with the food stores necessary for a 20-day stay in space.

The landing commission, after discussing the flight's progress and the crew's condition, decreed: "It is recommended to the state commission that the landing of the Soyuz-9 ship be carried out on 19 June." V.P. Mishin and K.A. Kerimov, having promised the high command in Moscow that they would carry the flight out to 20 days, will now have to concur with our decision.

17 June

In the morning, Kerimov, Mishin and I congratulated Nikolayev and Sevastyanov for setting an absolute world endurance record for a space flight.

The cosmonauts's state of health, judging by their reports and the telemetry data (pulse, respiration rate, temperature and arterial pressure), is not a cause for apprehensions of any kind. It is quite possible that we are standing on the threshold of an important discovery which will make it possible to convert weightlessness from Enemy No 1 into the "cosmonauts' friend." But, in order to prove such a possibility, it is necessary to have four-five ships for flights lasting 30, 40, 50 and 60 days. But we do not even have these ships. Even a year ago, I was pressing for an order for 10 Soyuz vehicles, but Karas, Zakharov, Kutakhov, Grechko and many other military and civilian leaders did not support me and now our cosmonauts have nothing in which to fly into space. When I return to Moscow, I am going to give all the bureaucrats one more fight and first among them will be General Karas who has always underrated the importance of manned flights.

I talked on the phone today with P.S. Kutakhov. He recommended that I not be in a hurry about flying the Soyuz-9's crew to Moscow so that the state commission members and the Air Force leaders would be able to be present when the cosmonauts are greeted at Chkalovskaya Airfield. These recommendations run counter to what I had secured for the cosmonauts—total post-flight isolation of the cosmonauts from outsiders and their transfer into the hands of the doctors for 10-12 days. Kutakhov also informed me that Marshal Grechko is getting ready to visit the Cosmonaut Training Center on the 20th of June and he ordered me to prepare the center and its personnel to receive the minister of defense. Grechko has still not been at the center, although he promised three times to visit it. I do not know if he will keep his word this time, but his possible trip to us does not make me very happy: the minister obviously underrates the importance of the space program for the country's science, economy and defense. However, we are totally dependent on Marshall Grechko and it would be foolish not to attempt to "relate" him with space.

18 June

The state commission has approved our suggestion about landing the Soyuz-9 on 19 June on the flight's 287th orbital revolution. In this orbital revolution, the descent passes over the Aral Sea and, in the event the ship has a problem with a controlled descent, it is possible to use a ballistic descent to have it land in the water. In order to rescue the crew of a ship which has splashed down, we have in the Aral Sea three amphibious craft, three helicopters, five sea launches and 15 fishing vessels.

Today, at the meeting of the CPSU Central Committee's Politburo, a decision was adopted, which I had been trying to get for nearly five years. Now we will send the cosmonauts from the ship's landing site directly to Moscow to the Chkalovskaya Airfield and hand them over to the care of the doctors. It took quite a bit of effort on my part to convince K.A. Kerimov, V.P. Mishin and other members of the state commission of the need to cancel the traditional welcoming of the cosmonauts at Vnukovo.

So, tomorrow is the final day of the longest space flight. I cannot rid myself of doubts and anxieties about the outcome of the landing, although there are no apparent causes for the apprehensions—I believe everything that could be done has been done to ensure that it will be successful. Now, the clocks read 11:30 pm, half an hour ago the Soyuz-9 went into the "deaf" orbital revolutions and now only tomorrow morning will we again hear the voices of the Sokol's.

19 June

At 2 pm, I personally took over all the communications channels and began supervising the Soyuz-9's descent. Sitting next to me were Mishin, Afanasyev, Kerimov and Agadzhanov and behind us was a full room of specialists (more than 150 people). There was an ideal silence in the room and everyone was waiting with bated breath for the reports over the radio.

We received the first report about the firing and cutoff of the TDU [breaking propulsion system] from Nikolayev over the KV [shortwave] channel. Then the crew reported on the separation of the ship's sections and the

increase in g-loads during the descent. The PVO [Air Defense] radars locked onto the Soyuz-9 over Turkey at an altitude of 83 kilometers and "tracked" it down to the parachute deployment altitude.... Nikolayev's report about the safe landing was greeted with a thundering round of applause from the entire room.

The crews of the search aircraft and helicopters visually observed the Soyuz-9 from the moment of its parachute deployment. Two helicopters, from which the ship's descent was being filmed, landed almost simultaneously with it—a minute later, General Goreglyad and Colonel Popov were already at the landing site. The cosmonauts could not get out of the ship by themselves and they were carried out on the arms of the comrades there to meet them. After receiving this report, I asked Kerimov, Mishin and Afanasyev to delay Nikolayev and Sevastyanov's flight from Karaganda to Moscow until 20 June. All three responded with a flat refusal, insisting on an immediate flight. In order to get approval to grant the cosmonauts a rest after a most difficult flight, I had to appeal through Kutakhov to L.V. Smirnov. Before taking off for Moscow, I phoned Mishin and informed him that the aircraft with the Soyuz-9's crew will arrive at Chkalovskaya Airfield tomorrow around 11 am.

At 4:30 pm, our Il-18 took off from Saki Airfield for Moscow. Assembled in my cabin were cosmonauts Leonov,Shatalov, Bykovskiy, Filipchenko, Khrunov and Gorbatko. We toasted the successful completion of Nikolayev and Sevastyanov's flight with a glass of cognac and a goblet of dry wine. A frank, businesslike conversation began. Everyone agreed that it is too early to dream of two and three-month flights: it is necessary to build a new batch of Soyuz vehicles, on which it would be possible to increase gradually the duration of the crews' stay in weightlessness. We agreed about the need to bring all our burning questions once again to the attention of Marshal Grechko and the government.

20 June

By 11 am, the members of the state commission, cosmonauts and close relatives had gathered at the Chkalovskaya Airfield to greet the crew. Afanasyev, Mishin and Kerimov expressed the desire that, after greeting Nikolayev and Sevastyanov, they would like to ride together with them to the Cosmonaut Training Center and to hold a meeting of the state commission there. My objections to this suggestion were supported by Marshal Krylov. It was decided that, before the cosmonauts disembark from the aircraft, I will go up to them and consult with them and the doctors about the welcoming procedure...

When I entered the aircraft's cabin, Sevastyanov was sitting on the sofa, while Nikolayev was at a small table. I knew they were having a hard time enduring the return to the ground, but I had not counted on seeing them in such a sorry state. Pale, puffy, apathetic, without the spark of vitality in their eyes—they gave the impression of completely emaciated, sick people. It was clear to me, without any advice from the doctors, that it is necessary to abandon the welcoming ceremony, to postpone the state commission's meeting and to drive the cosmonauts immediately to the dispensary under strict medical supervision. I asked Andriyan and Vitaliy, would they be able to get down the ramp by themselves? Although both responded affirmatively, I asked Shatalov to accompany Nikolayev and Yeliseyev to assist Sevastyanov. I told Nikolayev to keep his report to the minimum: "Comrade Chairman: The task for the flight on the Soyuz-9 ship has been fulfilled. The Commander of the Ship—Colonel Nikolayev."

Andriyan heeded my advice but could not restrain himself at the end of the report and, following established tradition, added: "We are ready to perform any other new task!.." After the report, he still managed to find the strength to hug and kiss his wife and to lift Alenka in his arms. He turned very pale from the effort and barely managed to remain on his feet—wisecrackers presented this moment in such a fashion that Nikolayev supposedly staggered and fell right after the phrase "We are ready to perform any other task!.." Without delay, we put Nikolayev and Sevastyanov into motor vehicles which took them to Zvezdnyy. The matter of the state commission's meeting faded away on its own: everyone understood that the cosmonauts need rest and the doctors' care now.

Details of 'Voskhod-1' Mission Recounted

907Q0011 Moscow SOVETSKAYA ROSSIYA in Russian 11 Oct 89 p 4

[Article by Col Gen Avn N. P. Kamanin: "'I Would Never Have Believed Anyone...'"]

[Text] **Twenty-five years ago, on 12 October 1964, a Voskhod spacecraft carrying three cosmonauts was launched by our country. That experiment, in which V. Komarov, K. Feoktistov and V. Yegorov participated, marked a new stage in the development of cosmonautics. A multiseat spacecraft was inserted into space orbit for the first time in the world, and it landed in the Kazakhstan steppes after more than a day in space. The crew of the Voskhod did not use pressure suits during that flight, also a first in the history of the conquest of space.**

Today, the editor's office publishes excerpts from a diary kept by Col Gen Avn N. P. Kamanin. There are many personal assessments in his notes, and some of the conclusions of the diary's author may seem debatable, but the value of that human document lies in the fact that it transports to us from the past the sense of the times in all of its complexity, and it reveals little-known pages of the difficult and complex epic of the conquest of space, in which every new step, every new victory was gained through the improbable efforts of human reason and courage of people who had dedicated their lives to the assault on space.

22 August

The Military-Industrial Commission of the USSR Council of Ministers held a meeting yesterday. Keldysh, Tyulin, Korolev, Pilyugin, Rudenko, Mrykin and others attended. Korolev reported the readiness of the launch vehicle and the Voskhod spacecraft.

Half a year ago, when the many scientific research institutes and special design offices had just begun modifying the Vostok into the Voskhod, designing a reliable multiseat spacecraft in such a short time seemed almost impossible. But under the guidance of the Military-Industrial Commission and Korolev personally, the whole industrial and scientific space "cooperative" carried out an enormous amount of work and conducted hundreds of additional studies and tests. And now we have a new craft that differs substantially in many characteristics from its predecessor. The three-seat Voskhod is equipped with a special braking device and an ionic orientation system making it possible to orient the craft manually in the absence of the sun. The crew of the Voskhod will fly without the cumbersome pressure suits, and it will land in the craft (the cosmonauts will not be catapulted) at a vertical speed close to zero at the moment of touchdown. The Voskhod also has a number of serious shortcomings. Most important among them is the absence of crew rescue equipment (in case of a launch vehicle accident) in the first 27 seconds of flight, and in the case of failure of the craft's parachute system during descent from orbit. Moreover, there is absolutely no way the Voskhod can land safely through natural deceleration—the reserves of air, water and food are small, and there is a high probability of overheating. The crew is very cramped in the Voskhod: There is five times less space and air in the craft "per capita" than in the Vostok.

In general, the life-support and safety conditions of the crew are considerably worse in the new craft than in the Vostok.

The question as to the composition of the Voskhod crew has not been examined; the commission has only acquainted itself with candidates for the flight—Komarov, Volynov, Katys, Feoktistov, Yegorov, Sorokin and Lazarev. Each of them briefly reported his readiness for the flight, and no questions were asked of them. The Military-Industrial Commission approved the State Commission's decision to launch a Voskhod test (unmanned) craft prior to 5 September and to perform the manned flight within the period of 15-20 September 1964.

25 August

I discussed the make-up of the crew for the Voskhod with Rudenko. I candidly told the marshal that I was not fully confident of Katys and Yegorov as candidates for the flight. Both of them passed the weightlessness tests with only a satisfactory score, and the doctors expressed doubts as to whether Katys and Yegorov could successfully complete a flight aboard the Voskhod. In the opinion of the doctors, Feoktistov also has serious "health defects." Were even one of the three Voskhod crewmembers to fall ill during the flight, it could result in a forced landing or an even more serious incident. I suggested that the marshal insist upon a more reliable crew make-up: Volynov, Komarov, Lazarev. Rudenko agrees with me in spirit, but he would hardly take a position contrary to Korolev, Keldysh, Tyulin and other members of the State Commission.

2 September

Tests in Feodosiya revealed a number of major defects in the Voskhod spacecraft's landing system. We would have looked rather stupid now, had we agreed with Korolev two or three months ago and waived field trials (dropping the spacecraft from an airplane). This once again confirms the haste and thoughtlessness behind many decisions of those in the OKB-1 [Special Design Office No 1]. Postponements of launches have now become a regular thing. It's now clear to everyone that a test Voskhod carrying mannequins cannot be launched before 15 September, and that a manned flight cannot occur until late September or early October. But Korolev is pestering all of his associates, and assuring them that before the year is out, he will launch the Vykhod—a modification of the Voskhod adapted for an EVA by a cosmonaut. As always, Korolev is in a hurry: He prefers a cavalry charge to well-conceived and methodically prepared offensives on the "space fortress." I must admit that he has been lucky in many things—all of the manned flights have come to a safe conclusion. But I can't ignore the long string of his failures in launching unmanned satellites and unmanned interplanetary craft.

14 September

Studied the Voskhod's emergency rescue system (ERS) on Launch Pad No 2 from morning on. Until the 27th second of flight, rescue of the crew in case of accident is virtually impossible. Rescue is possible but difficult from the 27th to the 44th second. The ERS can land the craft on USSR territory by up to the 501st second, and beyond our territory in the remaining period prior to insertion into orbit—the 523rd second. In all emergency situations, the crew members remain inside the craft, which lands by means of a parachute and jet system.

Korolev came in while I was working in the secret section and suggested that we talk one-on-one. We met a few minutes later in the technical management room and discussed the plans and objectives of forthcoming flights for more than two hours. We reached agreement that immediately following the Voskhod's flight, we would "get to work directly on a moon flight" together with the crew. Korolev told me how discussion of the problems of a moon orbit and a lunar landing expedition went in the Central Committee and Council of Ministers. In Sergey Pavlovich's opinion, a moon orbit using Chelomey's UR-500 rocket would be impossible without intermediate docking. Korolev said that he asked Chelomey to work on the docking procedure, but the latter decided to

make a new rocket, the UR-900, which would make it possible to avoid docking in space.

The make-up of the Voskhod's crew turned out to be the most difficult issue in our talk. I candidly presented my point of view to Korolev. The flight conditions of the Voskhod would be incomparably more difficult than the Vostok, and it would be best to send the physically fittest men into space. My preference was Komarov, Volynov and Lazarev. But considering political and scientific interests, we could also make up a crew consisting of Komarov, Feoktistov and Lazarev. In that case, the crew would include a civilian who has been working many years already in efforts to create space technology and who has invested much work into the development of Vostok, Zenit, Voskhod and other spacecraft.

Korolev said that he would categorically oppose Lazarev's candidacy, and suggested his version of a crew—Komarov, Feoktistov and Yegorov. In his opinion, Yegorov was better prepared for both flying and for future scientific activity.

In the end, we agreed that Komarov would be the Voskhod's commander, and Feoktistov would be the science researcher. The question as to the physician remained unresolved. Sergey Pavlovich remained displeased with the results of our talk. The last thing I wanted to do was fight with Korolev, but, unfortunately, that was not my first serious disagreement with him.

15 September

Talked to Korolev on the phone. He expressed displeasure with the fact that the instructions to the Voskhod crew on the ERS and on radio communication was signed by Gagarin and approved by Vershinin. He was perturbed by the fact that such important documents were drawn up without him. I gave my consent to rework the documents and to add the signatures of Tyulin, Korolev and Kamanin. This incident is very typical of Korolev. He insistently defends the interests and authority of the chief designer, and reacts angrily to attempts at resolving any problems associated with spaceflights without his participation. He wants to know everything, and to decide everything himself.

18 September

During a meeting of the State Commission, Chertok, Korolev's deputy, admitted that misfiring of the parachute hatch cover on the Voskhod during tests in Feodosiya was the fault of the OKB-1. The main hatch firing circuit has serious flaws, and it is not backed up, which doesn't introduce any confidence as to its reliable work in the future. Korolev, who spoke after that, said that the electric circuit was being rebuilt from scratch, and that its principal components will be backed up. He consented to preparing and conducting new tests of the Voskhod in Feodosiya, but he asked the State Commission to permit launching of the Voskhod with mannequins in the last days of September regardless of the Feodosiya tests

After the official part of the meeting was over, Tyulin asked Korolev, Mrykin, Kerimov, Rudenko and me to stay. Communicating that the Central Committee and Council of Ministers were wondering about the make-up of the crew for the Voskhod, he had submitted a proposal in the name of himself and Korolev to send Komarov, Feoktistov and Yegorov into space. Mrykin and Kerimov supported this proposal. I then had to talk long and hard to describe all of the difficulties of flying aboard the Voskhod, and I suggested appointing Lt Col Lazarev as the third member of the crew. Korolev tried to interrupt me several times, he was perturbed by my assessment of the conditions of a Voskhod flight, and he disagreed with my comparison of the qualities of Yegorov and Lazarev as candidates for the crew. It took a great deal of effort on the part of Tyulin and Mrykin to calm Sergey Pavlovich down. I was supported by Rudenko, but while he was talking he made a tactical error, saying that we would report our proposal for the crew of the Voskhod to the Council of Ministers. That announcement elicited a new outburst of anger from Korolev: "The air force is perpetually jamming up the works! Looks like I'm gonna have to train my own cosmonaut test pilots...."

24 September

Talked with all candidates for the Voskhod crew at the Cosmonaut Training Center. They look good, they've finished their training completely, and they're patiently waiting to be summoned to the proving ground. Each of them carries the hope that he would fly aboard the Voskhod. I told them: "You have all been prepared for the flight, and each of your chances are equal. No one knows yet who's going to fly, and you'll find out two or three days before the flight." Although the decision was certain in regard to Komarov and Feoktistov, and possibly Yegorov as well, it was not yet final: Any one of the three could be replaced.

Met with Marshal Rudenko at the end of the day. He communicated that he had spoken with Tyulin on the phone and had given him his consent in behalf of the air force commander-in-chief for a crew consisting of Komarov, Feoktistov and Yegorov. And so, Rudenko capitulated completely before Korolev, and Vershinin agreed to the change without a word. Neither marshal wants to fight Korolev's whims. They don't give a damn for the opinion of specialists—doctors and hero-cosmonauts—and they care more for their own well-being. My task has become incomparably more difficult, and I haven't yet decided what I should do in this situation. I openly stated my opinion as to the make-up of the Voskhod crew to everyone, but it was obviously useless to belabor the State Commission with it.

29 September

Met with Korolev in the morning in the courtyard of the assembly-and-testing building. Sergey Pavlovich was very downcast: His wife, Nina Ivanovna, was in the hospital, and she was to undergo major surgery on 1 October. Under those circumstances it was difficult for

him to be calm and to focus all of his thoughts solely on the work, but this is the very time when, in the days just before the launch, maximum performance and the most persistent attention to all details is required of the chief designer.

We were met in the assembly-and-testing building by proving ground liaison officer Col Kirillov and the Voskhod's chief engineer Frolov. They reported a delay in installing one of the seats in the craft—it turns out that the seat's fastening bolts are almost 3 millimeters out of alignment with the holes in the spacecraft's side. Before the spacecraft was moved to the proving ground, it was assembled and tested at the plant, and everything was all right there: Apparently the skin of the spacecraft deformed somewhat during travel.

An important meeting was held on the disposition of men and equipment in the event of an accident during the launch. Korolev is doing a lot in behalf of crew rescue in an emergency situation—he knows better than all of us that the Voskhod's reliability is insufficient. But from my point of view, all of the measures being implemented in that regard are not very effective, and they are more of psychological value.

Just before a meeting of the State Commission scheduled for 1700 hours, a major problem was reported in one of the Voskhod's systems—failure of the "sweeper." The meeting began an hour late; everyone listened to the reports on the readiness of the launch vehicle and spacecraft with their heads low: We already knew for certain that the problem that had been found would delay the launch by six-seven days (chief designer Bogomolov confirmed failure of the "sweeper" and the need for completely dismantling the spacecraft).

Korolev spoke after the official part of the meeting, in the presence of only the members of the State Commission. He reproached the leadership of the proving ground and the missile forces for its passive attitude toward the safety of people working in the assembly-and-testing building. Gen Mrykin, Gen Zakharov and Gen Kerimov and Col Kirillov voiced their opposition to measures proposed by Korolev to increase safety. Tyulin, Pravetskiy and I supported Korolev's proposals. The missilemen resisted a long time, but they were compelled to yield to our pressure.

Korolev was very agitated today, and he was unable to restrain himself from fighting with Frolov, Bogomolov, Kirillov, Mrykin, Kerimov and others. But all of his "carryings-on" are no longer as effective as they used to be three or four years ago. Korolev was going over the edge, and he did not want to understand that the main reason for the shortcomings and mistakes lay in the absence of a firm plan, in the haste and senseless prodding of executors. It was clear a good half year ago that a flight of Voskhod in August would be unrealistic, but Korolev stubbornly insisted on a launch in August, and then in September. And it was only today that he was persuaded that we won't be able to avoid launch delays even in October.

1 October

Yesterday evening, Bogomolov boasted that the work of dismantling and reassembling the Voskhod was 40 hours ahead of schedule. But the reason we are always ahead or behind schedule is poor planning of preparations of spacecraft for flight. Korolev announced in a certain meeting on 29 September that two launches of the Voskhod were to occur in November, even though it was well known to everyone that they would be impossible before March-April 1965. Haste, thoughtless planning and the race to surpass the plans are doing a lot of harm, sharply decreasing the quality of the work and creating many other unpleasant situations.

5 October

At 3 o'clock in the afternoon, Rudenko, Tyulin, Korolev Mrykin, Kerimov and I visited the cosmonauts at their hotel; the cosmonauts had arrived at the proving ground the day before. They do not yet know for sure who will fly aboard the Voskhod, and they are alertly waiting for something to be clarified in a talk with the leadership of the State Commission. After lunch, during which the cosmonauts treated us to some tasty fish soup, everyone set off for the recreation center. Korolev and I sparred on the tennis court for a little while. Sergey Pavlovich used to play a reasonably good game, I recall, but he's put on some weight, and he had a hard time hitting the ball.

Toward evening, the State Commission held a meeting—Bogomolov was "ground down" for an entire hour for the failure of the "sweeper." Bogomolov desperately defended himself. Then we listened to reports of the readiness of the rocket and the spacecraft for launching. We decided to launch the Voskhod with two mannequins on 6 October at 1000 hours Moscow time.

8 October

Bad news: During a scheduled live burn of Kosberg's engine on a test stand, high-frequency oscillations arose in the combustion chamber, causing disintegration of the engine. The leadership of the State Commission convened immediately in order to discuss the resulting situation. A decision was made to delay manned launching of the Voskhod three or four days, and to try to clarify the cause of the high frequency oscillations. Kosberg's engines had already been used in several dozen launches, and oscillations never arose in any one of them. But this was already the fourth time that oscillations arose during a live burn on a test stand. Korolev feels that they are the consequence of a poorly equipped test stand (the engine's horizontal position, the great length of the fuel pipelines, and so forth). Most specialists hold the same opinion, but it has not yet been confirmed by tests.

11 October

The day before yesterday the State Commission discussed Kosberg's report on the causes of the high-frequency oscillations in the third-stage engines. He stated that the engines were reliable—oscillations had never arisen during flight, and their appearance in the live burns can be explained by imperfections in the test stand. Everyone who spoke agreed with Kosberg. Then Korolev reported on the last two successful drops of the Voskhod from an airplane in Feodosiya, and on the excellent results of the craft's flight and landing with mannequins aboard. A decision to launch the Voskhod with a crew on 12 October at 1030 hours Moscow time was made on the basis of the reports of the system developers and the proving ground liaison officer's report of the readiness of the rocket and spacecraft for flight. Reporting the readiness of the seven cosmonauts for the flight, I proposed Komarov, Feoktistov and Yegorov as the crew. The State Commission unanimously approved that proposal. Gagarin, Rudenko, Korolev, Tyulin and Mrykin expressed their wishes for a successful flight to the crewmembers.

At 6 o'clock in the evening, Tyulin, Rudenko, Pravetskiy and I gathered together for a meeting with Korolev in his office. Bogomolov arrived soon after and reported that a flaw had been discovered in the rocket three hours earlier; its correction would require replacement of the "sweeper's" transmitter. That report enraged Korolev. He called Bogomolov a "cowardly gutter snipe" and announced: "I don't want to have anything more to do with you. Go away—I can't even be in the same room with you!" It was a very uncomfortable scene, though I knew that Sergey Pavlovich was perturbed more by the untimely report of the transmitter's failure and Bogomolov's flippant announcement that it would take 10 minutes to correct the flaw (Kirillov had reported that the transmitter's replacement would take two hours). With that outburst of rage, Korolev toppled himself from his pedestal as a talented organizer into the mire of petty passions. In four years of joint work, that was the first time I had ever seen him in such a state. I was sad and sorry for Sergey Pavlovich. It was 15 minutes before he was able to calm himself down and coherently report tomorrow's flight to Ustinov by telephone.

Yes, tomorrow the world's first three-seat manned spacecraft will ascend into space! Half a year of anxieties, doubts and disappointments associated with the hard work of large collectives were behind us. I have greater faith today in a successful flight by the Voskhod than a month and a half or two months ago, though I know for certain that the overall reliability of the craft and crew is lower than in any of our previous manned flights.

I want to believe in success—today we need to forget all doubts, and get to work!

12 October

A quiet, frosty morning. The thermometer reads -8, gentle winds, cirrus clouds, visibility over 20 kilometers—almost ideal weather for a launch.

At 0800 hours local time, the State Commission convened 200 meters from the rocket for its prelaunch meeting. All designers of rocket and spacecraft systems reported briefly and confidently: "Everything is ready for launch, there is nothing to be doubted." Korolev stated his conclusion from the reports of the designers: "The rocket can be fueled and launched." Karpov reported that the crew was ready, and I confirmed the readiness of the airborne cosmonaut-and-spacecraft search-and-rescue units.

Now that cumbersome pressure suits need not be put on, the prelaunch preparations of the crew have been simplified, and their time has decreased sharply. At 0900 hours the cosmonauts were about to leave for the launch pad when Korolev telephoned and asked them not to leave without a signal from him. He added that a minor defect had been revealed in the rocket, which in his opinion should not delay the launch. At half past 10, Korolev and Tyulin looked in on us. They were pleased by the appearance of the cosmonauts, and after exchanging a few jokes they left for the launch pad.

Half an hour later, Korolev, Gagarin, Nikolayev and I met on the launch pad. Fueling of the rocket was proceeding normally. At 1015 hours, the bus carrying the cosmonauts arrived at the launch pad. Clothed in light woolen uniforms, their appearance seemed odd near a rocket being prepared for launch. Perhaps that was why it was somehow hard to believe that three cosmonauts were about to ascend into space together for the first time, and for the first time without pressure suits.

Korolev, Kirillov, Gagarin, I and the launch crew were at the rocket one hour before takeoff. Korolev was outwardly calm, but I knew that he was only trying to conceal extreme agitation. Attempting to distract himself from anxious doubts, he spoke to me: "Are you tense, Nikolay Petrovich? Well, that's natural—I'm shaking myself...." Five minutes before takeoff, we entered the bunker. The rocket began to climb exactly on schedule. The launch proceeded normally, but every second seemed so long to us in anticipation of the cherished count of "523"! Finally a collective sigh of relief: The Voskhod spacecraft had safely reached orbit with three cosmonauts aboard.

I headed the second shift of the flight control operations groups (the first was led by Kerimov, and the third by Prevetskiy). During my night shift (it included generals Zakharov, Kuznetsov and Babiychuk, as well as over 60 specialists), Korolev and Tyulin telephoned for information on the flight's progress several times. I asked them not to worry, and to rest—there were no serious grounds for concern. I was of course somewhat anxious about the growing temperature in the craft's cabin: It climbed from 15° to 21° in the first six orbits. There was also some

concern for Yegorov—his pulse dropped to 46 while he slept. General Babiychuk began drawing the terrible pictures of space sickness before me. I radioed Komarov and asked him to take Yegorov's pulse. Komarov soon reported back: "Pulse 68." A few minutes later Yegorov's good health was also confirmed by telemetric data.

At 3 o'clock in the morning, I left the command post after asking Gagarin, who worked the third shift, to be sure to communicate with the crew and update the information on Yegorov's condition and the cabin parameters.

13 October

After the situation aboard the Voskhod, the condition of the cosmonauts and the conditions for transmitting the commands to descend were analyzed, a decision was made to land the craft at the beginning of the 17th orbit. The flight program for a full day had been completed, and another day in orbit (the crew had asked to lengthen the flight by another day) would not have added anything to the success already at hand.

We could have received confirmation from the Voskhod crew via the shortwave channel that the re-entry commands had been received (that was the way it was done in the flights by Nikolayev, Popovich and Bykovskiy), but that channel was not working—once again there was no communication with the spacecraft for several minutes. Reports that commands to turn on the landing orientation and braking engine unit had been transmitted came in from our seagoing vessels by the African coast, but the information was late, and it did not provide complete certainty that the re-entry was proceeding normally. Straining our ears, we all listened impatiently for signals confirming activation of the braking engine and separation of the re-entry vehicle from the onboard systems section.

Our huge Krug direction finders got a fix on the descending Voskhod over the Caucasus. Reports from Gen Kutasin began coming in from the air force command post: "The craft is approaching the vicinity of Kustanay.... The command to blow the parachute hatch cover has been transmitted."

And once again the oppressive silence on the airwaves...

According to the clock, the parachute system should have already been activated and the antenna in the parachute cords should have begun emitting signals to aid in locating the craft. But the signals did not come! At best, that meant failure of the transmitter or breakage of the antenna; at worst, failure of the parachute to open, and the unavoidable death of the crew. Everyone held their breath in tense anticipation of the signals.... Finally Kutasin's voice was heard: "Pilot Mikhaylov aboard an Il-14 sees an object in the air, 40 kilometers east of Maryevka." I realized from that that the re-entry was proceeding normally, but Korolev was not satisfied with the report from Kutasin. Sergey Pavlovich tore the microphone out of the radio operator's hands and queried in a highly agitated voice: "Fifty-Two, this is Twenty. Tell me, how many parachutes does Mikhaylov see—one or two?" Kutasin replied that the pilot saw the spacecraft descending with two parachute canopies. Now all that was left to do was to wait for activation of the braking slider.

But then another report from Kutasin: "Pilot Mikhaylov sees the Voskhod spacecraft on the ground, and three people near it, waving their arms." The last words of this message were drowned in the thunder of applause. Korolev spoke quietly, almost in a whisper: "Is it really true that it's all over, and that the crew has returned from space without a single scratch? I would never have believed anyone that the Voskhod could be made out of the Vostok, and that three cosmonauts would fly it into space...." Yes, we were lucky beyond reason! There had been many doubts and anxieties, but now all of that was behind us—our space program had won yet another outstanding victory.

At my suggestion, the State Commission adopted a decision to deliver the cosmonauts from the landing area not to Kuybyshev, as had been done prior to this, but to Tyuratam. Medical examination of the crew could be organized better here, all of the designers would be able to hear the report of the cosmonauts about their flight, and there would be less grandstanding of all sorts.

We expected that in Kustanay, to where the cosmonauts were delivered immediately after landing, they would speak with Khrushchev on the telephone. But at around 3 o'clock in the afternoon, Smirnov sent a message from the Council of Ministers: "The cosmonauts will not wait for their talk with Khrushchev—you can take off for the proving ground."

14 October

Komarov, Feoktistov and Yegorov reported the results of the flight to the State Commission in the first half of the day, in the presence of over 200 industrial and military representatives. Feoktistov honestly admitted that he sometimes felt that he was "flying upside-down," but that did not hinder his work. Yegorov said that he perpetually felt as if he was "standing on his knees with his head lowered."

During a luncheon arranged by the leadership of the State Commission to honor the crew of the Voskhod, toasts were raised to the health of the cosmonauts, Korolev and all who prepared for the flight. After the luncheon, while the cosmonauts were meeting with the proving ground's launch support team, Vershinin's order to immediately take off for Moscow was transmitted to Marshal Rudenko. Prior to his take-off, Rudenko telephoned the commander-in-chief and learned from him that a CPSU Central Committee Plenum was to be held that evening. The message concerning the plenum was a complete surprise to us. It seemed from everything that something unusual was happening in Moscow.

15 October

The report we prepared for Komarov to give at Red Square, and the speeches the cosmonauts were to give were cancelled. The evening before we were warned from Moscow that the salutation of the report (a reference to Khrushchev) would be different, and it was this morning that we officially learned of Khrushchev's replacement and the appointment of Brezhnev as first secretary of the CPSU Central Committee and Kosygin as the chairman of the USSR Council of Ministers. The news stunned everyone. Brezhnev, Suslov and Kosygin had displayed great boldness and outwitted one of the most cunning people of modern times.

I did not think that Khrushchev would fall so quickly, though it was clear that he no longer had a place as the head of state....

Tyuratam was already deserted by yesterday, and today Korolev and Tyulin took off for Moscow as well. Prior to their flight, they talked at the airport with the cosmonauts and air force representatives who were to remain behind at the proving ground. No one spoke aloud about the changes at the top, though everyone's thoughts were occupied by the subject. Tyulin and I tried to persuade Korolev not to be in a hurry to launch the Voskhod. I told Sergey Pavlovich that with the situation the way it was, there was no need to hurry with the next space flight. The promise Korolev made to Khrushchev that the Voskhod would fly in November had lost its power, and the success attained with the three-seat Voskhod was "enough to last us" for three or four months—time we so needed in order to perfect the pressure suit of the cosmonaut who was to perform an EVA. Although Korolev never did express firm agreement with postponing the launch of the Voskhod to March-April 1965, his former plans were clearly shaken.

French Prepare for Joint Flight in 1992

LD3101190491 Moscow TASS in English 1830 GMT 31 Jan 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow January 31 TASS—Two French pilots Michel Tognini and Jean-Pierre Haignere have begun pre-launch training at the Cosmonaut Training Center near Moscow.

Tognini is well known in France and the Soviet Union. He was a backup pilot of French astronaut Jean-Loup Chretien during the second Soviet-French joint space flight in 1988. Haignere is taking part in the Soviet-French international program of manned flights for the first time.

One of the two Frenchmen will travel into space together with Soviet cosmonauts in 1992.

Haignere is now working intensively to master the Russian language. TASS was told at the USSR Chief Space Administration Glavkosmos. Tognini comes to his aid here. Both pilots have begun training under the general program to prepare cosmonauts for space flights. Here, too, Tognini can help his countryman.

Tognini was welcomed as an old-timer. During his previous stay in the Soviet Union, Tognini married a resident of the Star City. He now returns with his wife Yeleni and a small daughter, who turned one year old recently.

Soviet-French cooperation in space exploration, specifically in the field of piloted cosmonautics, has a rich history. French astronaut Chretien took part in joint Soviet-French space mission twice—in 1982 and 1988.

Two British Cosmonaut Candidates Resume Training

LD2602235691 Moscow TASS in English 1827 GMT 26 Feb 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow February 26 TASS—After a short interval, two Britons—Helen Sharman and Timothy Mace—today resumed their pre-launch training at the Cosmonaut Training Center near Moscow.

Last week they were in London where it was finally decided that Sharman would train among the first crew and Mace among in the second one.

The lift-off is scheduled for May 12, this year. The trainees now have a busy schedule practicing the flight program on the Soyuz-T spaceship training facility, handling most diverse unconventional situations that may arise in space and polishing their knowledge of the Russian language.

Deputy Flight Director Blagov Interviewed on Reentry of 'Salyut-7'

917Q0046A Moscow RABOCHAYA TRIBUNA in Russian 30 Jan 91 p 3

[Interview with Deputy Flight Director V. Blagov by Andrey Filippov; date and place not given: "Is It Impossible To Change the Meeting Place? How the Flight of the Salyut-7 Station Will End"—first three paragraphs are RABOCHAYA TRIBUNA introduction]

[Text] The Salyut-7 Station "lived" in space for 10 years. And it would have flown more, but the unexpected happened. Of course, everyone knew that during the year of an active sun the atmosphere of earth "swells." And satellites will brake against it. But in order to so strongly....

The station and the classified Kosmos-1686, which is docked to it, began to descend markedly. Had the object been in working order, they would have "stepped on the gas" and again it would be aloft. But....

"In connection with the exceeding of the life by many fold it is impossible to guarantee the reliable operation of the systems of the station," the conclusion of the working group of specialists on the state of the Salyut-7 Station states. "There is no fuel in the ODU (unified propulsion system). Moreover, the electric power supply system of Kosmos-1686 has failed."

[Blagov] If we are to be precise to the end, Deputy Flight Director V. Blagov says, the conducted analysis suggests that with a 50-percent probability there may still be about 70 kg of fuel in the tanks of the station. It is possible to attempt to control it. To "put" the complex at the necessary angle when entering the dense layers of the atmosphere. If necessary, perhaps, we will risk pushing the complex with one or two burns for one or two revolutions. But there is no certainty that the control command will go through.

[Filippov] Will our fighter-interceptors shoot down the Salyut-7—Kosmos-1868 orbital complex with an air-to-air missile, if its fall represents a threat to a population center or industrial facility?

[Blagov] We have not turned anywhere in this regard and have not made provision for the case that we would shoot the station down with a missile. But it is clear to me: The station must not be destroyed in space. There will be many fragments, and, hence, the area of coverage of the earth's surface by them will increase. The pieces, which survived and did not burn up after the fall in the atmosphere, can land right on different continents. From the standpoint of safety it is better that the station fall compactly. And drop somewhere in the ocean. In much the same way as the Progress space freighters.

[Filippov] What is the danger for cities and population centers in this case?

[Blagov] The deorbit of the complex does not add anything to the normal meteorite danger for earth. Did you know that hundreds of meteorites can fall to earth daily? But do you sense their danger? So it is here as well.

Look at the globe. Here is the zone, which girdles the planet and is confined by 51 degrees north latitude and, further, down through the equator, to 51 degrees south latitude. This is also the zone, at some unknown point of which the orbital complex will fall. Or its parts, which are different in size and weight, if it disintegrates in the dense layers of the atmosphere. Three-fourths of this zone is water surface. One-fourth is dry land. For the most part sparsely populated. All this theoretically makes the risk minimal. Although, you yourself understand, if it is fated, a brick will also fall on the head of a person in the middle of Tverskaya Ulitsa in Moscow, where this supposedly should not happen.

[Filippov] Is it now possible to indicate specifically the region of the fall?

[Blagov] It is impossible to do this due to the instability of the upper atmosphere boundary. We will know approximately the point of entry of the complex into the dense layers sometime the day before this event. The region of the fall to earth will depend on at what angle the complex enters the atmosphere. The lift-drag ratio of the object will also play a role. Roughly speaking, how it will glide. While we regard 7 February as the expectation of the date of the fall. Plus or minus three days.

Now about what we are observing over the combat zone. All of Iraq was covered by clouds until 24 January. But then clear weather set in. We see that oil fields are burning. There is smoke from fires over Baghdad. In the gulf ships are clearly distinguished, the entire fleet is clearly visible. On 25 January we noticed there a burning disabled tanker. There is one fire in Saudi Arabia and several fires in Kuwait. In short, we are not finding any surprises that would differ from the reports which have passed military censorship. We will continue the observations of the war zone.

Factors Determining Accuracy of Prediction of 'Salyut-7' Reentry

917Q0047A Moscow PRAVDA in Russian 31 Jan 91 pp 1, 6

[Article by Doctor of Technical Sciences Professor M. Nevolko: "When and Where Salyut-7 Will Fall"—first two paragraphs are PRAVDA introduction; last paragraph is PRAVDA conclusion]

[Text] The less time remains to the fall of the Salyut-7 orbital station to earth, the more attention this event is attracting. How unusual is the formed situation? Is it possible to predict the regions, which are subject to danger, and to warn about it in advance? On what does this depend?

Here is what specialists think with regard to these questions.

The fall to earth of objects of natural space origin is if not an everyday phenomenon, then at any rate a well-known one. In a year more than 700,000 tons of meteorite matter fall to the surface of earth. True, reports on the fall of meteorites to earth, particularly large ones, are encountered extremely rarely, since nearly all of them burn up in the dense layers of the atmosphere.

Objects of artificial origin, which are a consequence of the development of space, have become a supplement to natural space objects. At present more than 7,500 objects measuring more than 10 cm are in space. Of them only 5 percent are actively operating space vehicles.

Meanwhile from time to time increased interest is displayed in individual space vehicles that are falling to earth. Such was the case with the USSR space vehicles Kosmos-954 (1978) and Kosmos-1402 (1983), which were equipment with nuclear propulsion plants, and the large Skylab orbital station (the United States). Whereas the first two objects caused legitimate apprehension mainly due to the possible radioactive contamination of the terrain and the environment, the third object caused anxiety mainly due to the high probability of the fall to earth of large fragments, which did not have time to burn up in the dense layers of the atmosphere.

At present the question of the Salyut-7 orbital station, which owing to a number of circumstances has proven to be in a state of uncontrollable motion, is being discussed extensively in the mass media. The factors, which led to the appearance of such a situation, are being examined, data (often contradictory) on the calculations of the probabilities of the determination of the time and regions of the fall of the station and its fragments with allowance made for the influence of solar activity on the state of the atmosphere and others are being cited. Meanwhile the availability of experimental-theoretical data on the forecasting of the time and regions of the fall of the above-cited three objects also provides grounds to refine a number of assumptions with reference to the Salyut-7 orbital complex.

Diverse forces—the attraction of the earth, the moon, and the sun, light pressure, the resistance of the atmosphere—act on a space object. The correlation of these forces depends on the parameters of the orbit of the space vehicle and, in particular, on the flight altitude above the earth's surface. The resistance of the atmosphere has a significant effect on the movement of satellites with flight altitudes of less than 1,000 km. Under its influence the flight altitude of these satellites constantly decreases and they sooner or later enter the earth's atmosphere: from an orbit 800-900 km high—in several tens or even hundreds of years, while from 200-300 km—in several days or weeks. Such a spread is explained by the fact that the density of the atmosphere with a decrease of altitude increases rapidly. At an altitude of 300 km it is a factor of 10 less than at an altitude of 200 km and the same amount greater than at an altitude of 450 km.

Moreover, the density of the atmosphere depends on the state of the sun. Against the background of the 11-year cycle and other more or less regular changes with shorter periods the density of the atmosphere is also subject to daily random disturbances. They are connected with solar flares, the development of sun spots, and other phenomena that at present have been poorly studied. In addition to a direct effect on the atmosphere, from time to time these processes cause magnetic storms, which in turn through the magnetosphere disturb the atmosphere. As a result the density of the atmosphere changes randomly daily and these fluctuations at different altitudes can come to 30-60 percent. The basic difficulties of predicting the time and regions of the fall of space vehicles, which are moving in the atmosphere, are also connected with their consideration. Given the present knowledge about our nearest star—the sun—and the possibilities of forecasting the processes, which are connected with solar activity, the errors of the estimation of the time that space vehicles cease existence come, according to the estimates of our and foreign specialists, to 15-20 percent of the remaining lifetime. In case of a relatively quiet sun the accuracy of a prediction can also be higher. Thus, a month before the fall the error of a prediction can come to two to six days, while a week before it can come to one-half to two days. A day before the fall to earth the revolution, in which the space vehicle will enter the dense layers of the atmosphere, can be determined with a high probability, while on the day of the fall in case of favorable conditions the prediction of the region of the fall is narrowed to one-tenth of a revolution.

The experience of tracking the descent of Kosmos-954, Skylab, Kosmos-1402, as well as others confirms the made estimates of the accuracy of the time and regions of their fall to earth. Thus, while tracking the Kosmos-954 space vehicle the error of the one-week prediction came to 1.9 days, for Kosmos-1402 it came to less than half a day, while for Skylab it came to 2.4 days. The difference in the accuracy of the prediction is explained by the fact that the flight of Kosmos-954 and Kosmos-1402 took place during a quieter sun, while that of Skylab took place during high solar activity.

The time of the entry into the atmosphere of the indicated space vehicles was predicted three days before the fall with an error of two-three hours. At the same time the error of the entry into the atmosphere of one of the fragments of the Kosmos-1402 space vehicle three days before the fall comes to 21 hours. This large error was due to a strong magnetic storm two days before the entry of the fragment into the dense layers of the atmosphere.

Given a relatively calm atmosphere and the possibility of observing the descent of the Salyut-7 station on the last revolutions of the flight four-five hours before entry into the dense layers of the atmosphere the predicted region

of the fall will be on the earth's surface a band 50 km wide and several thousand kilometers long. This makes it possible is necessary to issue the appropriate warnings.

[Box, p 6]

At present the flight of the Salyut-7 station is proceeding under high solar activity at altitudes of 230-250 km, and its fall is expected during the first 10 days of February. As the experience of the tracking of the fall of similar space vehicles testifies, two-three days before the fall the course of motion of the Salyut-7 station can be calculated with high precision. Therefore, at this time it will already be possible to say that the Salyut-7 station will fall within a quite narrow, about 100-km wide, helical band which girdles the earth two to three times. The distance between the revolutions of the helix at the equator comes to more than 2,000 km. The number of revolutions of this helix decreases rapidly with the approach of the time of the fall. A day before the fall this is already one revolution of the helix, while several hours before the fall this is a fraction of a revolution.

Blagov Suggests Maneuver To Influence 'Salyut-7' Reentry

LD2801100291 Moscow Domestic Service in Russian 0420 GMT 28 Jan 91

[Excerpt] New data have been received on the most probable fate of the Salyut-7 orbital station. Ballistics experts at the flight control center assert that the station will enter the dense stratum of the atmosphere between February 4-10. You will now hear the details from Viktor Dmitriyevich Blagov, deputy chief of the flight.

[Blagov] We are monitoring the station's flight every day, and over the last month we have started using additional orbit-monitoring facilities to get more accurate forecasts of the end of its existence. We have estimated that the most probable date for the station to come down will be February 7. Perhaps that date will have to be defined somewhat more precisely, but unfortunately today one still cannot say in what area the fragments of the disintegrating construction will fall. We will be able to do that more or less precisely, with some kind of probability, 24 hours before it falls. We will warn the Soviet Ministry of Foreign Affairs so that it can inform those countries that may receive fragments. But we hope, as dry land occupies one-sixth of the globe, that the probability of fragments falling on land is not a high one. Moreover, it is possible that we either will be lucky, and the station will fall in the ocean, or we will try to perhaps undertake some minimal measures—apply the minimal possibilities we presumably have.

I will explain my idea. The station has been in flight for nine years. Many of the onboard systems have been switched off, and are not operating at the present time. To influence the station's flight in some way, one has to switch on the directional system, let us say, and change the direction the station is going. If, let us assume, if the station is flying sideways or not in a frontward direction at all, it makes a difference in timing, a difference in the station's resistance to the atmosphere—and from this it can be seen that one can somehow influence the pass of its fall. That is, one can change the area of its fall within the bounds of one or two passes. But these systems need to work. There is no certainty of that, as they have repeatedly used up their resources. But one can, in principle, make an attempt like that—and then one will see what happens as the deadline draws closer. [passage omitted]

Air Defense Spokesman Gives Details on 'Salyut-7' Reentry

LD0102190791 Moscow TASS in English 1740 GMT 1 Feb 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow February 1 TASS—The Soviet Salyut-7—Cosmos-1686 space station is expected to cease to exist between February 6-7, Soviet anti-aircraft defence spokesman Mikhail Shpitalnik told a news conference today.

Shpitalnik noted that Soviet anti-aircraft defence troops were constantly monitoring the flight of the station, and the more exact time for it to cease existence will be announced three days before the moment.

In spite of the station's total weight of some 40 tonnes, only the descent capsule of the Cosmos-1686 satellite could pose some danger of coming down and hitting the earth's surface, he said.

The weight of the capsule reaching the earth will depend on the level of its burning up in the atmosphere and could amount to 1.26 to two tonnes. The most probably site of the crash will be forecast some 24 hours before the station ceases to exist, Shpitalnik said.

Soviet Deputy General Machine-Building Minister Yuriy Koptev noted that all interested countries are constantly receiving information about the flight of the station and forecasts of its possible "behaviour".

Specialists Comment on 'Salyut-7' Problem

PM0402171191 Moscow PRAVDA in Russian 4 Feb 91 Second Edition p 6

[Report by special correspondent A. Tarasov: "It Is Twisting and Turning and Wants To Come Down... Salyut-7 Nears the End"]

[Text] As of today, Monday, the Flight Control Center task force tracking the descent of the 40-tonne Salyut-7—Cosmos-1686 combination is on round-the-clock duty. The space ballistics experts, mathematicians, and controllers, backed up by air defense "eyes" and metering systems, must not get their forecast wrong.

At the end of last week Yu. Koptev, chairman of the task force set up by decision of the government and deputy

minister of general machine building, carried out a review of available manpower and resources in the Flight Control Center's blue conference hall.

M. Shpitalnik, representative of the Air Defense Forces, recalled that the radar systems monitoring outer space routinely track the almost 7,000 objects travelling over USSR territory today. Salyut-7 is one of them and has been monitored from the very day of its launch, 19 April 1982. As of 1 February the altitude of its orbit was 230.4-214.7 km at apogee and perigee. Its rate of descent was 4-6 km per day. According to the calculations carried out that day the possible date of the "termination of the craft's existence" is the latter half of 6 February through 7 February. The state of the upper layers of the atmosphere could influence the date in one direction or the other.

"We will give a date with greater probability three days ahead of the time, and it will be possible to talk about the actual orbit 24 hours ahead of the time..."

Prof. V. Pokuchayev, leader of the Flight Control Center ballistics service, also complained that the upper layers of the atmosphere are capricious and made precise calculation difficult. Their density and consequently their braking force are impossible to predict "from a distance." Hence the elasticity of the long-term forecast, including 8 February.

Can the 50-70 kg of fuel left in the station's tanks help? Everything will become clear if you bear in mind that at least 500 kg are needed for a real boost. Nevertheless, cosmonaut Vladimir Solovyev, the flight director, considers that even these dregs could be used. If not for a short boost, then at least to tilt the communication satellite to help it use its "sail" to undershoot or overshoot an undesirable spot. "The motor can be engaged only once, at the requisite moment, when you are absolutely certain that you are going to improve rather than worsen the situation."

Then V. Pallo, the chief expert on the future debris, deputy chief designer of the "Salyut" Design Bureau, which created the two vehicles, spoke. His chart showed up to 250 fragments capable of surviving the heat of atmospheric friction and reaching the earth's surface. The smallest items will be nuts and bolts, the largest the Cosmos-1686 reentry vehicle. It will weigh 1,260-2,045 kg, depending on burnup. He assured people that the solid-fuel motors for a soft landing are "empty," as its reentry was not envisaged. Meanwhile there will be "fragments" of the propulsion unit, turbopump units, combustion chambers, blast deflectors, spherical tanks, and other heat-resistant components.

The huge area these handfuls of fragments will fall is comforting. The area will depend upon the altitude of destruction: If it starts at 100 km, distribution will be over 9,000 square km; if at 80 km, over "only" 4,000 square km... But, just in case, we have already started looking at the Convention on International Responsibility for Damage Caused by Space Objects, adopted 29 March 1972. What has it in store for us this time?

Negligence Said To Be Factor in 'Salyut-7' Crisis

PM0502094991 Moscow IZVESTIYA in Russian 5 Feb 91 Union Edition p 2

[Article by S. Leskov: "'Salyut-7': Do Not Expect A Soft Landing"]

[Text] The "Salyut-7" orbital complex is getting closer and closer to the earth's surface. The speed of its uncontrolled descent is increasing, and there are just 190 km left before it reaches the earth.

This year IZVESTIYA has twice (Nos. 6 and 15) discussed the dramatic events surrounding the "Salyut-7" orbital complex. According to latest forecasts—if these are not disrupted by unforeseen atmospheric storms—"Salyut-7" can be expected to fall to earth sometime during the second half of 6 February or on 7 February. It will only be possible to calculate the landing site a few orbits before the event.

The seriousness of the problem is shown by the fact that an operational group under the leadership of Yu. Koptev, USSR deputy minister of general machine building, has been set up to determine an action plan for the final phase of the orbital station's flight and to eliminate the consequences of its landing—if, of course, there are any. The operational group began work 1 February, it unites specialists from the Defense and Foreign Ministries, the scientific and design organizations involved in developing and operating the complex, and representatives from the State Commission for Emergencies.

The preliminary estimate is that around 250 fragments will reach the earth's surface. Rain induced by space debris will cover an area 4,000-9,000 km long and 80-105 km wide. The velocity of the descent will reach 150 meters per second. But these fragments will not be large. The greatest danger will be posed by the "Cosmos-1686" descent module which is docked with "Salyut-7." This impressive sphere 3 meters in diameter weighs 2.5 tonnes.

Yu. Koptev reported that, following requests from abroad, the Soviet side has given NASA, the European Space Agency, and the Italian and Japanese national space agencies all the data relating to the trajectory and characteristics of "Salyut-7." A proposal was made for the orbit to be jointly monitored [kontrol], but no reply has yet been received. Under international regulations all countries on whose territory fragments could land will be officially informed 24 hours before the landing. Is the danger great? One would imagine that we could fall back on statistics. After all, every year fragments of dozens of spacecraft fall to earth, but they have never yet caused any direct damage. That may be so, but in 1979, after fragments of the Soviet nuclear-powered "Cosmos-954"

landed in Canada, we had to pay out more than $10 million to cover the cost of remedying the environmental consequences of the incident. Any number of unexpected things could happen. It is not surprising that, when the "Skylab" space station was in an uncontrolled descent about 10 years ago, the Americans took the precaution of organizing a prestigious group of lawyers to assess the validity of any possible claims against the United States. But one would hope that this time things will not reach the point where the competence of our lawyers has to be tested.

If the landing is expected to occur on our territory, the operational group should quickly inform local soviets, civil defense headquarters, and regional emergency committees about the danger. It should be borne in mind that the specific orbit on which the landing will happen will only be known six hours before the event. And the landing area will be known even later. USSR Defense Ministry search and rescue services and specially equipped air-defense services will be involved in this work.

The station's orbit will be monitored from data provided by operational on-board systems, as well as with the help of air-defense radars. Unfortunately, despite the fact that many of the station's systems are in working order, its descent is uncontrollable because there is virtually no fuel left in its integrated fuel tanks. It would take around 500 kg of fuel to shift 40 tonnes in the necessary direction out of its orbit, but no more than 70 kg is available [natsedit]. But it has been decided not to miss even a small chance of influencing the trajectory. A few drops of fuel could be enough at best to turn the station in the necessary direction, thereby altering drag. Admittedly we need above all to make sure that the "Salyut-7" attitude control system, which has not been engaged for two years, is still operational. If it is working normally, then Mission Control's ballistics specialists will attempt a task that has not yet been achieved in space history: to spin a falling station and land it in an unpopulated area.

This crisis situation is quite typical; it arose as a result of an explosive synthesis of negligence and unconsidered, hidden external factors. It had been planned to land "Cosmos-1686" in a safe area. But now, apart from the risk of the actual landing, is there any guarantee that there are no dangerous elements aboard the descent module? This is by no means an idle question. After all, when fully loaded, the descent module in the craft series "Cosmos-1686" belongs contained two cesium instruments, several solid rocket engines, and heptyl fuel, more dangerous than mustard gas in terms of its effect on humans. And there was that unfortunate incident around 10 years ago when a similar craft landed in Kazakhstan. The machine operators who were first to reach it decided to help themselves to certain parts, intending to use them to stun fish. As a result they were severely burned and it was only by a miracle that their sight was saved.

But this time, General Designer G. Yefremov guarantees, a landing phase was not envisaged from the outset and so the descent module is equipped with absolutely nothing that could pose a danger to over-curious collectors of space debris. But, as is well known, God helps those who help themselves. Since there is no prize on offer from the space department for finding the remnants of the orbital station, it is better to keep as far away from it as possible.

'Salyut-7' To Fall 6-7 Feb, Little Damage Expected

LD0502151591 Moscow TASS in English 1449 GMT 5 Feb 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow February 5 TASS—Soviet Flight Control Center officials told TASS that the apogee of the descending Salyut-7- Cosmos-1686 space complex was 190 kilometers and the perigee—176 kilometers, today at 15:30 Moscow time.

Specialists believe the station will most propably fall to earth between 20:00 on February 6 and 24:00 on February 7 Moscow time.

Representative of the Air Defence Forces Mikhail Shpitalnik told TASS that the complex had been closely followed since it was put into orbit. All radar facilities will be switched on at the flight's final stage.

Soviet Deputy Minister of General Machine Building Yuriy Koptev noted that many booster rockets and spacecraft end their orbital flights by falling back to earth every year. Although the complex weighs about 40 tonnes, only the descent capsule, a part of the Cosmos-1686 satellite, may cause harm.

The capsule's weight at touchdown may vary between 1.2 and two tonnes, depending on its reentry burn-up. The most probable area of impact can be calculated several revolutions before reentry.

According to specialists, the fragments will not inflict much damage. Researchers have calculated that about 250 fragments would fall to earth. Each of them will weigh several kilograms.

The Soviet side intends to inform the public regularly about the flight's final stage and has expressed readiness to exchange information about the main parameters of the complex's flight with competent organisations in other countries.

The Flight Control Center was entrusted to exchange information with appropriate organisations in other countries. The Salyut-7 station put into orbit in April 1982 was the last one in the series of the second generation spacecraft. According to specialists, it could have operated for several more years. But solar activity suddenly increased in 1988, and the station began sharply to descend.

Researchers decided that it was inexpedient to reactivate the complex.

Flight Control Center Team Formed To Monitor Descent

LD0402094391 Moscow Domestic Service in Russian 0700 GMT 4 Feb 91

[Text] Beginning today, an operations group will start a 24-hour watch at the Space Control Center on the descent of the 40-ton Salyut-7-Cosmos-1686 space complex. Space ballistics specialists, mathematicians, and flight controllers, with the aid of measuring instruments of the Air Defense Forces, must ensure that they do not make any miscalculations in their forecasts. The complex has been monitored since its launch on 19 April 1982.

According to calculations, the space vehicles will cease to exist on 6 or 7 February. The time frame may vary depending on the conditions of the upper payers of the atmosphere. The descent orbit can be calculated the day before the ground, having passed through the burning-out level of the atmosphere. What is of some comfort is that the area on which the fragments will fall is vast. The form of destruction of the space vehicles will depend on its height above the Earth's surface—at the height of 100 kilometers it will disintegrate into 9,000 fragments; at the height of 80 kilometers into 4,000 fragments.

'Salyut-7' Reentry Coordinates Reported

LD0702054291 Moscow TASS in English 0534 GMT 7 Feb 91

[Text] Moscow February 7 TASS—The Soviet Salyut-7-Cosmos-1686 space complex entered the atmosphere over a site in South America with coordinates: Latitude 34.9 degrees south and longitude 63.8 degrees west.

Soviet tracking stations confirmed that the complex burned out of existence.

Debris Hits Argentina, No Damage Reported

LD0702090391 Moscow TASS in English 0758 GMT 7 Feb 91

[Text] London February 7 TASS—The Soviet Salyut-7 space station reentered the atmosphere at about 07:00 Moscow time today, falling in an area in the Andes mountains, near the Chilean border, REUTERS reported today, citing U.S. space command.

Parts of it were intact when it hit the ground at more than 27,000 kilometers (17,000) miles per hour, it said.

There were no reports of victims or damage.

Soviets Ready to Compensate for Any 'Salyut-7' Damage

LD0702181891 Moscow TASS in English 1754 GMT 7 Feb 91

[By TASS correspondent Nikolay Zheleznov from the Moscow region Mission Control Center]

[Text] Moscow February 7 TASS—All Soviet long-distance space communication centers, including ground and ocean-based complexes, have done all they could for lessening the damage that could be caused by the crashing of the Salyut-7—Cosmos-1686 orbital complex.

According to Yu. Kotlyarov, chairman of the commission for coordinating the work of all services engaged in this intricate operation, a maneuver of the orbital station was carried out on the eve of its entry into the thick layers of the earth's atmosphere. The purpose of the maneuver was to turn the station replacing its rotation axis, which would allow it to crash into the Atlantic Ocean near the South American coast. Unfortunately, the fuel reserves at the station, as well as the ability to control actively its descent, were limited, which prevented the maneuver from being carried out in full volume.

A commission, which included specialists in ballistics and Soviet specialists in dealing with emergency situations, worked in close cooperation with staff members of the Soviet Foreign Ministry and the U.S. National Aeronautics and Space Administration. Corresponding services in Latin America were informed beforehand by Soviet embassies about the expected time and place of the crash. Reports coming to Moscow from Buenos Aires and other capitals today contained only statements and impressions of witnesses of the "star rain" in Cordillera in a number of provinces along the Argentine-Chilean border. More detailed reports have not come so far. All embassies have been notified that the Soviet side is ready to compensate for the inflicted damage in accordace with the 1972 international convention, if some individuals or organizations submit corresponding applications to them.

'Salyut-7' Wreckage Found in Argentina, Chile

LD1102091191 Moscow TASS in English 0812 GMT 11 Feb 91

[By TASS correspondent Aleksandr Nyrkov]

[Text] Buenos Aires February 11 TASS—Fragments of the Soviet Salyut-7—Cosmos-1686 space complex, which entered the earth's atmosphere over Argentina, were found in the Entre Rios Province and in Chile on Sunday, the TELAM news agency reports.

An eight-kilogram metal ring with a diameter of 1.5 meters, which fell 130 kilometers from the city of Rosario, was discovered by a peasant in a field and taken to a police station.

A 3.2-meter pipe weighing four kilograms fell to the Andes near the Chilean city of Puerto Montt.

Background, Goals of 'Gamma' Project

907Q0132 Moscow PRAVDA in Russian 13 Jul 90 Second Edition p 8

[Article by Yu. Zaytsev, engineer, under the rubric "Our Commentary": "'Gamma's' Difficult Launch"; first paragraph is source introduction]

[Text] **At this point, it is hard to estimate just how many years in all the date had been pushed back for the launch of the space observatory with the largest gamma-ray telescope ever to operate in space. The telescope is intended for extra-atmospheric observations of the most energetic particles in the electromagnetic spectrum. Its operating range is from 50 million to 5 billion electron-volts. At last, on 11 July, the launch of the Gamma unmanned observatory took place.**

The cooperative effort, whose aim was to develop the Gamma-1 telescope, emerged in late 1972. It was made up of the USSR Academy of Sciences' Space Research Institute (the head organization), the USSR Ministry of Higher and Secondary Specialized Education's Moscow Engineering Physics Institute, the USSR Academy of Sciences' Physical Technical Institute imeni A. F. Ioffe, and a number of industrial enterprises. In 1974, the Center for Space Research in Saclay joined the effort, as did the Center for the Study of Space Radiation and the CNES in Toulouse (France). Later, the Polish Academy of Sciences and the Warsaw Polytechnical Institute joined the effort.

Each participant in the project was responsible for a specific system for the telescope. For example, the Polish specialists manufactured the Telezvezda [Telstar] star tracker, whereas the development of the electronics and the manufacture and adjustment of the telescope were performed in the Space Research Institute's Experimental Design Bureau in Frunze.

The first official date that was set for the start of operation of the telescope was 1982, and then, every year, the observatory's launch was also officially postponed. The reason was the delays in the development of the space platform on which the telescope was to be placed. The Progress craft was supposed to be its base unit. The very same craft that have been launched every year to the orbital stations (first to the Salyut-6, then to the Salyut-7, and today to Mir)—more than 40 have gone up.

Meanwhile, observations in the gamma band make it possible to take a look at the surrounding world through yet another previously inaccessible "window into the kingdom of the electromagnetic waves." The energy of the gamma-ray quanta exceeds that of visible light's particles—photons—by factors of tens of millions, hundreds of millions and billions. Gamma-ray quanta originate, for example, in thermonuclear reactions. Such processes, apparently, are the basis for the "vitality" of stars and take place during stellar flares and explosions of galactic nuclei. The gamma-ray quanta ejected during such large-scale cosmic explosions come to us from a unique natural laboratory, where matter exists in extreme states: extremely high temperatures, extremely strong magnetic fields, and intense radiation fluxes. It is physically impossible to create such conditions on Earth, which means that gamma-ray astronomy produces an opportunity to peek into the world of high energies, to "get a look at" and to study the processes that govern the world of the stars and the galaxies and that, in the final analysis, determine the development of the universe.

Gamma radiation can also represent a unique "litmus paper" sensitive to cosmic rays. It turns out that their place of origin can be found by observing high-energy gamma radiation. The fact is that, when the energetic nuclei of cosmic radiation interacts with the gas and dust of the interstellar medium, elementary particles are formed, which then decay into gamma-ray quanta. The greater the density of the cosmic rays, the brighter the medium surrounding their source "shines" in the gamma band.

That problem has yet another important aspect—the issue of the nature of those sources. Which of the objects in space are the gigantic natural accelerators that boost the particles to fantastically enormous energies? If the man-made accelerators on Earth, which stagger the imagination with their dimensions and their level of instrumentation, accelerate protons to energies in "only" the trillions of electron volts, then what must those natural machines be like, as they "shoot out" particles with energies whose magnitudes are expressed in figures for electron-volts with 19-20 places?

Another remarkable feature of gamma radiation is its high penetrating power. It is not affected by electromagnetic fields and propagates in a virtually straight line. Consequently, gamma-ray astronomy has the potential capability of "looking" farther than even radio astronomy and of "seeing" earlier epochs of the development of the universe. Special regions of the galaxy, such as its center, which is concealed by clouds of dust and gas, should also be "visible" in gamma rays.

Those problems—by no means a complete list—are stimulating vigorous research in cosmic gamma radiation. Why, then, have astronomers only recently begun the exploration of the gamma band?

The primary reason is that gamma radiation is absorbed in the earth's atmosphere, and only by taking measuring instruments out into space has it become possible to obtain the necessary information about it. But even in the vicinity of the earth, despite the fact that the gamma-ray quanta's energy is high, their flux is negligible. The astronomers literally hunt for each gamma-ray quantum. The observations of cosmic gamma-ray radiation must be conducted against an enormous background of secondary "local" gamma-ray quanta, which are formed,

for example, in the structure of a satellite when it is hit by charged cosmic-ray particles.

The efficiency needed for the observations could be provided by developing high-quality, high-energy gamma-ray telescopes and by launching space vehicles specially designed for that purpose. A prototype of such a telescope was the instrument that was developed at the Moscow Engineering Physics Institute and that was the first in the world to operate in space, on the Kosmos-251 and Kosmos-264 satellites. The instrument was completely different from the telescopes that are used for optical measurements. It was based on a spark chamber and various nuclear-radiation detectors.

Cosmonauts G. Dobrovolskiy, V. Volkov and V. Patsayev used such a telescope to make observations from aboard the Salyut orbital. The station's crew perished, but the research results were delivered to the ground.

Just what does our sky look like in gamma rays? First of all, invisible in that sky are not only the usual stars, but also the sun itself: high-energy gamma radiation has not been detected in our luminary. The Milky Way on the map of the gamma-ray sky looks like a bright, narrow band. The distribution of the brightness of the gamma radiation corresponds to the model of our galaxy that takes the form of a thin disk—a pancake—where the sun occupies a modest place closer to the periphery than to the center of the star system. Analysis of the scattered galactic gamma radiation has made it possible to draw the conclusion that the density of the cosmic rays at the edge of the galaxy is lower than in the vicinity of the sun, and that means that the primary sources of cosmic rays—as suggested by the Soviet scientist, Academician V. Ginzburg—apparently lie within the galaxy, not outside it.

The results that have been obtained give abundant food for thought and have made it possible to outline the paths for the further development of gamma-ray astronomy. In order to sort out the nature of the sources of both galactic and intergalactic gamma radiation, it has been necessary, on the one hand, to improve the observation equipment—to enhance the sensitivity of the gamma-ray telescopes and their angular and energy resolutions—and, on the other hand, to conduct simultaneous measurements in various bands of the electromagnetic spectrum. After all, gamma-ray sources are typically unstable and have a tendency toward bursts, and it is important to obtain comprehensive information about each specific phenomenon.

UDC 629.015

Evolution of Some Types of Earth Satellite Orbits

917Q0050A Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 28 No 6, Nov-Dec 90 (manuscript received 17 Apr 89) pp 803-807

[Article by M. A. Vashkovyak and M. L. Lidov]

[Abstract] The search continues for an orbit suitable for very long baseline interferometry. The eccentricity and semimajor axis should be large, and the orbital elements will undergo large changes over the span of several years. This work examines numerically and analytically the evolution of elements of separatrix and near-equilibrium orbits. These orbits have a perigee near Earth and an apogee of several hundreds of thousands of kilometers. It is found that the phase trajectory of the separatrix orbit falls in the area of libration change, and the period of libration is about seven years. The greatest changes in orbit are experienced in the first six months; thereafter they are attenuated. Highly elliptical near-equilibrium orbits with a large inclination to the ecliptic plane have variations of a librational character, the rate of evolution increases as the apogee distance increases. Figures 2; references 7 (Russian).

UDC 531.36

Spatial Rotations of a Satellite in a Circular Three-Body Problem for the Case of General Resonance

917Q0050B Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 28 No 6, Nov-Dec 90 (manuscript received 17 Apr 89) pp 808-819

[Article by P. S. Krasilnikov]

[Abstract] This article examines the problem of the resonant rotation of spacecraft around the center of mass in the gravitational field of two heavy homogeneous spherical bodies moving in a circular orbit relative to each other. The spacecraft is considered an infinitely small solid body. It is shown that the averaged equations of a dynamically-symmetrical satellite can be integrated in quadratures. Two or four equilibrium points may exist. The satellite's motion is described by quasi-periodic time functions. Its central ellipsoid of inertia is near spherical. The gravitational momenta cause a slow shift in the direction of the kinetic momenta. Possible loops in the spatial orbits are classified. Planar satellite orbits constitute a deformation of the loop into a closed curve of degree zero. Critical values of parameters at which the degree of the loop changes are found. The effect of the satellite's trajectory on its movement around the center of mass is studied. Figures 5; references 12: 11 Russian, 1 Western.

UDC 531.35:521.1

Oscillations of a Small-Mass Satellite Probe Caused by Aerodynamic and Gravitational Forces

917Q0050C Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 28 No 6, Nov-Dec 90 (manuscript received 17 Apr 89) pp 820-830

[Article by V. I. Zhuk and Ye. M. Shakhov]

[Abstract] This article examines the three-dimensional oscillations of a satellite tethered to a main satellite in the context of a model that considers diurnal variations in atmospheric density and the rotation of the atmosphere. The tether is an inextensible, flexible cable. The frequency of oscillations at the transversal point of relative equilibrium may substantially exceed the frequency of revolution of the main satellite, which is in a circular orbit. Because of this, several characteristic times can be determined in the system, and these may be used in space experiments. This is in contrast to other works which consider such oscillations undesirable. Oscillations are the result of aerodynamic drag, and may depend not only on the density of the atmosphere, but also on the density gradient. When the probe is heavy, gravity plays a greater role than drag. The oscillations may be used to study atmospheric density and other geophysical characteristics. Figures 7; references 7: 5 Russian, 2 Western.

UDC 531.391

Analysis of Necessary and Sufficient Conditions for the Equilibrium Stability of a Gyrostatic Satellite

917Q0050D Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 28 No 6, Nov-Dec 90 (manuscript received 23 May 89) pp 831-836

[Article by A. A. Anchev and V. A. Atanasov, Bulgarian Academy of Sciences]

[Abstract] The gyrostatic satellite has three rotors whose axes of rotation are along the main central axis of inertia of the satellite. The central axes of the satellite are directed along the axes of the orbital coordinate system. The satellite moves in a circular orbit. The necessary and sufficient conditions for stability of equilibrium attitude are calculated and analyzed. These results are compared with the results of other authors. Figure 1; references 7: 5 Russian, 2 Western.

UDC 629.78

Calculation of the Pointing Accuracy of Spacecraft Equipment Using Autonomous Measurements of the Angular Position of the Object of Investigation

917Q0050E Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 28 No 6, Nov-Dec 90 (manuscript received 15 Mar 89) pp 837-845

[Article by A. A. Chernov]

[Abstract] This article determines the pointing accuracy of a star tracking system that uses indirect pointing. Data on the position of the target are sent to the tracking system from the spacecraft's information and measurement system. The information and measurement system has only an angle measuring channel, which consists of an optical telescope and a radiation detector whose plane is orthogonal to the optical axis of the telescope. The pointing system uses combined control with compensation of perturbations. Delays in signal propagation are considered. It is assumed that there are no systematic pointing errors. Portions of the article are devoted to calculation of pointing errors in the scientific equipment and the scatter of positions in the photodetector. It is also assumed that the spacecraft moves without angular acceleration during the experiment. The probability of capture of the target in the instrument's field of view is calculated. Figures 2; references 6 (Russian).

UDC 319.25

Analytical Algorithms To Solve An Inverse Navigation Problem for a System of Satellites

917Q0050F Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 28 No 6, Nov-Dec 90 (manuscript received 26 Jan 89) pp 846-853

[Article by R. I. Braslavets]

[Abstract] A methodical approach is proposed for the development of analytical algorithms for the navigation of an observer-spacecraft from synchronous measurements of angular and linear parameters of the positions of several (two to six) reference satellites chosen from a system of satellites. Reference satellites create a navigation field that enables the unambiguous determination of the position vector of the observer. Formulas are obtained to calculate various types of navigation algorithms differing in their navigational parameters. Recommendations are given for formalizing the structure of several elements of navigation algorithms. The relative simplicity of the finite formulas of navigation algorithms and their independence from a priori information on the position of the observer-spacecraft will make it possible to implement them in future spacecraft to increase the reliability of navigation. References 3 (Russian).

UDC 629.197.2

Study of the Properties of the Autonomous Optical Navigation of a Space Probe in a Rendezvous With an Asteroid

917Q0050G Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 28 No 6, Nov-Dec 90 (manuscript received 6 Oct 88) pp 854-864

[Article by V. V. Ivashkin]

[Abstract] Several countries are developing programs to send probes to small solar system objects. This article examines properties of autonomous navigation for a spacecraft on such a mission. In this case the main spacecraft approaches the object for remote study, then releases a probe for a closer study. The probe brakes as it approaches the surface and releases rods which embed in the surface to study the soil While a high landing speed is required for the soil study rods, a soft landing is desired

for the probe. It is necessary to know the probe's exact distance from the surface. Previously, radar altitude measurements were made. This article examines the possibility of using optical navigation. Here the object of study is the asteroid Vesta. Navigation by measurement of the angular diameter of Vesta may be unsuitable. Sighting the asteroid on a star field is examined, and this method yields adequate results. Cases are examined where the distance to the target is known, as are cases where it must be determined. The examination includes a consideration of error analysis, and an analysis is made of the probe position determination accuracy and the landing speed accuracy of the probe. Figures 3; references 10: 9 Russian, 1 Western.

UDC 629.78.015

Fluid Damping of the Oscillations of Satellites With a Large Magnetic Moment

917Q0050H Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 28 No 6, Nov-Dec 90 (manuscript received 27 Oct 89) pp 865-873

[Article by M. L. Pivovarov]

[Abstract] The rotation of a satellite with a permanent magnet in the plane of a polar Keplerian elliptical orbit is examined. The damping of oscillations relative to a line of magnetic force by a viscous fluid which completely fills a cavity is considered. The period of the satellite's movement relative to the force line is much smaller than its period of rotation. Two cases are examined: when the cavity is of an arbitrary shape and its Reynolds number is small, and when it is toroidal and its Reynolds number is arbitrary. It is assumed the magnetic moment of the satellite is large. An averaging method is used to obtain analytical expressions which describe the decrease in rotational energy of the satellite and the damping of oscillations relative to the force line of the magnetic field. The effectiveness of the damper is proportional to the moment of inertia of the fluid. To decrease the volume of the damper, a dense fluid like mercury can be used. Figures 2; references 9 (Russian).

UDC (531.36+532.5):534.1

Experimental Study of a Toroidal Fluid Damper

917Q0050I Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 28 No 6, Nov-Dec 90 (manuscript received 6 Feb 90) pp 874-878

[Article by S. G. Gultyayev, M. L. Pivovarov, N. A. Eysmont]

[Abstract] This article describes an experiment which studies the two-dimensional oscillations of a body with a toroidal fluid damper. A model is proposed which is based on results from an earlier work in which one of the authors (Pivovarov) was involved. Oscillations around the vertical of a steel disk suspended on a steel cable were studied. The damper was a glass ring-shaped tube completely filled with fluid. The amplitude of the oscillations of the disk were recorded on an automatic recorder using a photoelectric system. Experiments were done with a damper filled with water and mercury and without a damper. A mathematical model is constructed of this experiment. Results are presented in figures. It was found that the model agreed well with experimental results. It appears from the figure that mercury was a more effective damper. Figures 3; references 12: 10 Russian, 2 Western.

UDC 533.951.2

Measurements of the Longitudinal Movements of O^+ Ions in the Subauroral Upper Atmosphere From the Aureol 3 Satellite

917Q0050J Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 28 No 6, Nov-Dec 90 (manuscript received 4 Jul 90) pp 886-889

[Article by L. V. Zinin, V. S. Solovyev, Yu. I. Galperin, V. A. Gladyshev, and S. A. Grigoryev]

[Abstract] The study of the longitudinal movements of thermal ions in the upper ionosphere, which dictate their outflow into the magnetosphere, is important in the physics of ionosphere-magnetosphere interaction. The main mechanism for this transfer is the polar wind. Recent experimental data have confirmed the polar wind theory for light ions, and indicated significant upward fluxes of thermal O^+ ions from the high latitude ionosphere. The question then arises of how well these longitudinal movements of O^+ are described by a nonsteady-state hydrodynamic model of the polar wind. These fluxes were measured from the F layer to 1,500 to 2,000 km by the Aureol 3 satellite, part of a Soviet-French collaboration. The DYCTION instrument used to make the measurements is described. It was found that at night there was a downward flux of O^+ ions, especially at high altitudes. In the early morning, the opposite was true for the F layer: O^+ ions moved upward at speeds reaching 400-700 m/s. The upwelling is due to a sharp increase in electron temperature due to the appearance of photoelectrons against a background of decreased nighttime electron concentration and temperature. There is qualitative agreement between the model and experimental data. Differences in the speed of ion avalanche are due to the actual nonmaxwellian distribution of velocities. Deviations in observed data are due to measurement error and the changing effects of geomagnetic activity and variations in ion temperature. Figures 1; references 11: 3 Russian, 8 Western.

UDC 550.370

Spatial Characteristics and Dispersion Correlations of ELF Radiation in the Earth's Bow Shock From Measurements Made on Prognoz 10. 2. Dispersion Correlations and Modes of ELF Waves. Wave Processes at the Feet of Bow Shocks

917Q0050K Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 28 No 6, Nov-Dec 90 (manuscript received 15 Nov 89) pp 903-918

[Article by S. A. Romanov, S. I. Klimov, and P. A. Mironenko]

[Abstract] This article studies wave processes in shock transitions with large Alfven Mach numbers and a one-to-one ratio of the thermal energy of the plasma to the energy of the magnetic field. Three intersections of Prognoz 10 with the Earth's bow shock are studied. The dispersion dependences of ELF waves in these regions are studied, and wave modes near the foot of the shock transitions are identified. This region provides information on processes occurring in the shock wave, yet it has relatively small amplitude oscillations. Nonlinear effects in this region are not as complex. Fluctuations in the magnetic field and current density are used to study wave processes in this region. A fast whistler mode and an intermediate mode consisting of ion-cyclotron and slow whistler components were found. The energy flux pumped through the decaying fast whistler mode is approximately equal to the energy losses of the directed flux of the solar wind in its transition through the shock wave. Figures 5; references 21: 9 Russian, 12 Western.

UDC 551.510.536

Estimate of the General Picture of Atmospheric Disturbance Due to Explosive Sources of Ultraviolet Radiation

917Q0050L Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 28 No 6, Nov-Dec 90 (manuscript received 6 Dec 89) pp 919-922

[Article by N. V. Yeliseyev, S. I. Kozlov, M. S. Reznikov, and A. I. Rudakov]

[Abstract] This article presents theoretical studies of disturbances in the Earth's atmosphere at 100-140 km caused by explosive discharges of ultraviolet radiation. It is at this altitude that effects are maximal. The dispersion of explosion products in the atmosphere is found by solving a gas dynamic problem. In spherically symmetrical charges of condensed explosive material the air temperature beyond the shock front may reach 5000-10000 K. While concentrations of N_2, O_2 and O remain virtually unchanged, concentrations of NO and N may increase by a factor of ten or a hundred. The effect of explosions on chemical reactions is outlined. The mechanism for this process is described. The spatial and temporal dependences of density and temperature are used to determine the concentration profiles of various components beyond the shock wave. Figures 2; references 12: 10 Russian, 2 Western.

UDC 629.7

Evolution of the Rotation of an Axisymmetric Viscoelastic Body in a Circular Orbit. Part II.

917Q0050M Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 28 No 6, Nov-Dec 90 (manuscript received 5 Apr 90) pp 943-947

[Article by I. S. Minyayev]

[Abstract] The author assumes a satellite to be an elastic-solid mechanical system moving relative to a center of mass, if the center of mass itself rotates in a circular orbit in the field of an attractive center. Deformations of the elastic part have no effect on movement. The case of a dynamically symmetrical extended body is considered where the equatorial moment of inertia is greater than the axial moment of inertia of the undeformed system. Deformations of the elastic part are calculated, and equations are developed to describe the system. The effect of dissipative forces is considered. It is assumed that the satellite moves quasi-statically and the characteristic time of movement of the system as a whole around the center of mass substantially exceeds the characteristic time of attenuation of free oscillations of the elastic part in the lowest frequency. The orbit has various stages of evolution. Here nonequilibrium rotations of the satellite around the equatorial axis in undisturbed movement are considered. In a slow dissipative evolution there is a monotonic slowing of rotation. References 3 (Russian).

UDC 537.591.4

3-10 MeV Proton Flux in a Quiet Period of Solar Activity According to Data From Vega 1 and Vega 2.

917Q0050N Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 28 No 6, Nov-Dec 90 (manuscript received 27 Feb 90) pp 947-950

[Article by M. A. Zeldovich, Yu. I. Logachev, V. G. Smolpovskiy, M. P. Verigin, K. I. Gringauz, and I. N. Krimenko]

[Abstract] Vega 1 and 2 measurements of proton intensity at 3.2-4.5 and 4.5-13 MeV and α particle intensity at 3-13 meV/nucleon were obtained during the 21st solar minimum (December 1984-February 1986). It appears that the spatial structure of fluxes of energetic particles in the interplanetary medium at 1 a.u. at solar minimum is primarily dictated by the shortened regions of interaction of fluxes of solar wind with fluxes of energetic particles. Cosmic ray flares distorted this structure. IMP 8 data is introduced for comparison. The minimum

average daily intensity varied by more than an order of magnitude over time. High values of minimum intensity preceded solar cosmic ray flares. In the majority of quiet times the proton spectrum could be given as a power law $dI/dE^{-\gamma}$, with γ the same over the entire energy range. Minimum proton intensity values from various solar cycles are compared. The minimum intensity value for 3.2-4.5 MeV protons, $(8.1+3.3) \times 10^{-3}$ was measured on 22-24 March 1985. The character of the change in minimal intensity over time was identical for 1 MeV protons (IMP 8) and 3.7-4.5 MeV protons (Vega 1 and 2), which indicates the identical origin of background fluxes of protons at these energies. The background intensity of protons is affected by a number of factors (galactic and solar cosmic rays, local particle acceleration, solar proton events) to varying degrees. At solar minimum, galactic particles may make a substantial contribution to the 1 MeV background proton fluxes with a substantial decrease in the contribution of other sources. Figures 4; references 10: 4 Russian, 6 Western.

UDC 521.352

Perturbations of the Orbit of the Etalon Satellite Due to Nongravitational Forces

917Q0054 Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 67 No 6, Nov-Dec 90 (manuscript received 26 Mar 90) pp 1315-1325

[Article by V. P. Bass and S. K. Tatevyan, Astronomical Council, USSR Academy of Sciences]

[Abstract] Accurate determination of a satellite's position in orbit and changes in its orbit can be used to determine periodic variations in the Earth's rotation, variations in the gravitational field, and variations in other geophysical forces. In Earth orbit, a position accuracy of 1 cm is required. The American satellite LAGEOS is ideally suited for such studies. In 1989 the USSR launched Etalon-1 and -2 for this purpose. This article examines nongravitational orbital perturbations. The main sources are aerodynamic braking forces due to the satellite's interaction with neutral and charged particles of the upper atmosphere (10^{-12}-10^{-14} m/s^2) and solar pressure (10^{-7} m/s^2). These perturbations are difficult to model because of their parametric indeterminacy. The effects of radiation reflected from Earth on the satellite while it is in the Earth's shadow are calculated, as are the reflective qualities of the satellite's exterior. Figures 5; references 10: 4 Russian, 6 Western.

UDC 550.383:523.62.726

Detection of Fluxes of High-Energy Electrons on 'Cosmos-900' Artificial Earth Satellite Associated With High-Velocity Recurrent Solar Wind Fluxes

917Q0019A Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 30 No 5, Sep-Oct 90 (manuscript received 4 Sep 89) pp 850-851

[Article by Ye. V. Gorchakov, K. G. Afanasyev, V. A. Iozenas and M. V. Ternovskaya, Nuclear Physics Institute, Moscow State University]

[Abstract] Cosmic-ray measurements on the Cosmos-900 satellite were made in a near-polar orbit at an altitude about 500 km using a global Cerenkov detector with a large geometry factor. In the first channel the instrument registered protons with an energy greater than 400 MeV and electrons with an energy greater than 15 MeV. Protons with an energy greater than 600 MeV and electrons with an energy greater than 30 MeV were registered in the second channel. The article describes an event occurring on 18-19 July 1977 in which electrons with an energy greater than 15 MeV were detected in the outer regions of the magnetosphere. The maxima of the particle fluxes were at L = 5.5-10. The intensity increase coincided in time with a magnetic storm. A small (two percent) Forbush decrease was observed by neutron monitors with a gradual decrease and recovery of intensity, characteristic for recurrent Forbush decreases. On 16 July the velocity of the solar wind had increased to the maximal for the month of July, but the value of the D_{st} index changed negligibly. This represented the first instance of detection of generation of electrons with energies 15-30 MeV in a wide range of magnetic shells, including shells close to the boundary of the magnetosphere. The generation of these electrons was associated with the Earth's entry into a high-velocity recurrent flux. Figure 1; references 2 (Western)

550.385.524.1:523.9

Dynamics of Equatorial and Polar Boundaries of Penetration of Solar Protons With Energy About 1 MeV Into Magnetosphere During Strong Magnetic Storm

917Q0019B Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 30 No 5, Sep-Oct 90 (manuscript received 1 Feb 90) pp 856-858

[Article by L. A. Darchiyeva, T. A. Ivanova, E. N. Sosnovets and L. V. Tverskaya, Nuclear Physics Institute, Moscow State University]

[Abstract] Research on the asymmetric injection of ring-current particles on the basis of direct measurements on a single satellite does not make it possible to obtain the global picture of particle injection because the satellite intersects only two narrow sectors LT. Accordingly, a study was made of the dynamics of the equatorial and polar boundaries of penetration of solar protons into the magnetosphere on the basis of published data from simultaneous measurements on three artificial satellites during the phase of development and at onset of the recovery phase of the strong magnetic storm of 3-4 April 1979, supplemented by data from the world network of magnetic observatories. It was found that the extremal approach of the boundary of penetration of solar protons with an energy about 1 MeV to the Earth occurred several hours before the storm maximum and with a minimal latitudinal position of the polar electrojet. Quasiperiodic movements of the polar boundaries of solar protons in the magnetosphere, associated with a

series of substorms in the process of development of a world magnetic storm, were discovered. Figure 1; references 10: 8 Russian, 2 Western.

UDC 550.385

Modelling the Dynamics of Fluxes of Electrons With Energies 30-300 keV in Geostationary Orbit

917Q0019C Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 30 No 5, Sep-Oct 90 (manuscript received 20 Nov 89) pp 866-868

[Article by V. I. Degtyarev, G. V. Popov and S. S. Sheshukov, Siberian Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Siberian Department, USSR Academy of Sciences]

[Abstract] A model of the dynamics of electrons with energies 30-300 keV along a geostationary orbit was constructed. The purpose of the model was a diagnosis or prediction of the state of the medium at a specific moment in time on the basis of input parameters (geophysical and heliophysical indices). In this model the electron flux I with the energy E acting on a satellite in a geostationary orbit at a specific moment in universal time can be described by three components: (1) asymmetry of drift shells of electrons in a "stationary" magnetosphere; (2) adiabatic change in fluxes of electrons associated with slow deformation of drift shells with a change in solar wind parameters; (3) nonadiabatic changes in electron fluxes occurring during a substorm and "injection" events. The model was used in an analysis of data for the period 10 March-16 June 1986. Measurements were made in six channels in the energy range 30-300 keV on three satellites situated approximately uniformly along a geostationary orbit. Each of the satellites carried identical particle spectrometers. An analysis of the spectra of variations gives basis for representation of the change in electron fluxes in the course of a 24-hour period in the form of an expansion into a Fourier series. As an illustration, the results of use of the model for a retrospective prediction of the mean hourly fluxes of electrons in a geostationary orbit are given (on the basis of K_p, D_{st} and AE) for a day with average magnetic activity during which several substorms were observed. Figures 1; references 8: 3 Russian, 3 Western.

UDC 524.423:520.2

Early Stars in Vicinity of Orion Star Association OB1 Determined From Observations With 'Glazar' Space Telescope

917Q0020A Yerevan ASTROFIZIKA in Russian Vol 32 No 2, Apr 90 (manuscript received 28 Nov 89) pp 197-202

[Article by G. M. Tovmasyan, R. Kh. Oganesyan, R. A. Yepremyan, M. A. Mkrtchyan, Yu. M. Khodzhayants, M. N. Krmoyan, A. L. Kashin, D. Yugenen, Yu. V. Romanenko, A. P. Aleksandrov, V. G. Titov, M. Kh. Manarov, A. A. Volkov and S. K. Krikalev, Granit Special Design Bureau, Byurakan Astrophysical Observatory; Geneva Observatory; Cosmonaut Training Center]

[Abstract] The Glazar telescope, installed in the Kvant module of the Mir space station, was used in November 1987, January 1988 and January 1989 for observations of the vicinity of the Orion star association OB1. Telescope pointing was stabilized with an accuracy about 30' with exposure times of up to four minutes. With such exposures, during the first observations a limiting star magnitude about 11^m was attained at a wavelength of 1640 angstroms; subsequently, the sensitivity dropped off by 1.0-1.5 star magnitude. A figure shows an image of the observed regions, with annotation of the photographed stars. The monochromatic fluxes of 57 of these stars were measured earlier at wavelengths of 1565, 1965, 2365 and 2740 angstroms using observations made with the TD-1 space telescope. Fifteen of the stars had been observed with the ANS telescope at 1500, 1800, 2200, 2500 and 3300 angstroms (12 of these also were observed with the TD-1). All these stars were used as standards for the new observations. The star magnitudes of the stars observed at 1640 angstroms, together with a number of other parameters, are given for each star in a table. The errors in determining star magnitude do not exceed $0^m.3$. The spectral type of one of the discovered stars, 0507-00, is unknown. However, since its image was obtained on Glazar photographs at 1640 angstroms it is postulated that it is a star of the type OB or early A. It may also be an invisible blue component of a star of a later spectral type. Figures 1; references 8: 1 Russian, 7 Western.

UDC 524.7-77:520.27

Observations of Radio Galaxy IC 4296 With RATAN-600

917Q0020B Yerevan ASTROFIZIKA in Russian Vol 32 No 2, Apr 90 (manuscript received 19 Feb 90) pp 354-356

[Article by K. D. Aliakberov (deceased), Special Astrophysical Observatory, USSR Academy of Sciences]

[Abstract] Observations of the radio galaxy IC 4296 were made in March 1982 in the southern sector with the flat reflector of the RATAN-600 at the three frequencies—960, 3650, 3950 MHz. This radio galaxy was also observed in the northern sector at frequencies of 2300, 3650, 7700 MHz. The RATAN-600 observations refined the spectra of individual components of an extensive radio source associated with IC 4296 and are important because they supplement observations with aperture synthesis systems with low sensitivity to large details. The measured flux densities of the main components of this radio galaxy, earlier known as the radio sources RKS 1332-33, RKS 1333-33 and RKS 1334-34 (NW, central and SE components), are given in Table 1. The NW component of the

radio source has an appreciably steeper spectrum than the SE component. This correlates with the fact that the NW component is closer to the nucleus of the galaxy than the SE component. The differences in the spectra can be attributed to the fact that the adiabatic losses due to expansion and possibly diffusion of relativistic electrons in the NW source components are less than in the SE components. The intensity of low-frequency radio emission of the NW component is greater and its spectrum is steeper as a result of relatively higher synchrotron losses of energy by relativistic electrons in magnetic fields of a greater strength than in the SE component. The enormous size of the radio source is evidence of its great lifetime, so that the influence of synchrotron losses in actuality should be observed in the observed range of radio waves. Figures 1; references 6: 2 Russian, 4 Western.

UDC 523.72:523.43

Turbulent Processes of Mass-Loading of New Ions on Venus and Mars and the Problems of Numerical Models of the Interaction of Solar Wind With These Planets. 1. Characteristics of the Flow of Solar Wind Around the Planets

917Q0051A Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 28 No 6, Nov-Dec 90 (manuscript received 14 Dec 89) pp 923-935

[Article by T. K. Breus and A. M. Krymskiy]

[Abstract] Initially thought to be due only to solar wind/comet interactions, loading of the solar wind with heavy ions has been found to be the result also of interactions with planets. It is a universal phenomenon near nonmagnetic and slightly magnetic solar system objects. An overview of previous investigations is given. On Venus, loading is most intense in the transition region near the ionopause. The ions are rapidly accelerated in laminar and turbulent fields. The conditions for the capture of new heavy ions by the solar wind vary substantially with distance from the planet surface and the solar zenith angle. It is impossible to determine the pressure of heavy ions for hydrodynamic calculations without kinetic calculations. Hydrodynamic models developed at solar minimum were found to be inadequate at solar maximum. A two-fluid model with anomalous friction between species of ions is used to describe the flow of the solar wind around Venus and Mars. The friction is due to turbulent acceleration processes in the transition region. Figures 3; references 39 (Western).

UDC 535.24:523.43

Characteristics of Aerosol in the Atmosphere of Mars According to Data From the KRFM Experiment

917Q0051B Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 28 No 6, Nov-Dec 90 (manuscript received 15 Feb 90) pp 936-942

[Article by V. I. Moroz, Ye. V. Petrova, L. V. Ksanformaliti, L. Esposito, J. P. Bibring, M. Combes, A. Soufflot, O. F. Ganpantserova, N. V. Goroshkova, A. V. Zharkov, and G. Ye. Nikitin]

[Abstract] The KRFM experiment on Fobos 2 consisted of an infrared radiometer and filters, and a 0.32-0.60 μm prism spectrometer. Photometric profiles of Mars were obtained in eight spectral bands from 320 to 550 nm. The equatorial region of Mars was studied from limb to limb. Some details of the profiles are associated with atmospheric aerosol. Quantitative analysis of aerosol properties is difficult because of the number of parameters needed. An interpretation of the data yielded three types of aerosol: (1) constant haze (mineral dust) mixed with gas; (2) ice haze at the surface at night; (3) high-altitude clouds. The article examines types 1 and 3. The absorption properties are those of basalt mixed with goethite. The optical depth, 0.3, is virtually independent of wavelength. The particle size distribution is wide. Figures 4; references 15: 10 Russian, 5 Western.

UDC 523.42-834

Results of Morphometric Analysis of the Tesserae Surface of Venus According to Venera-15 and -16 Data

917Q0053A Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 24 No 4, Oct-Dec 90 (manuscript received 11 Jun 88) pp 288-295

[Article by M. A. Ivanov, Vernadskiy Institute of Geochemistry and Analytical Chemistry, USSR Academy of Sciences]

[Abstract] Tesserae occupy nine million square kilometers of the surface of Venus. Tesserae are raised above the surrounding surface and are crossed by systems of intersecting and parallel ridges and linear depressions. Ridges are peaked and depressions are V-shaped. Tesserae regions can be differentiated by the distances between their ridges—the spacing. The purpose of this article is to determine the spacing of various tesserae regions and to determine the patterns of the distribution of spacing. The distance between ridges was found to vary from 2 to 38 km, with an average of 6-11 km. The global dependence between the area of the tesserae and their average height is calculated. A two-layer model of tesserae structure is presented, and calculations are done to determine the thickness of the upper deformed layer, which is estimated to be 1-2 to 3-7 km thick or 0.5-1 to 1-2 km thick, depending on the model used. It may be defined by the topography of the tesserae. Topography may be supported by upwelilng matter or by buoyancy. Buoyancy is assumed here, and values are determined for different tesserae regions (Fortuna, Tellura, and Laima) and compositions (basalt, feldspar). Figures 4; references 9: 4 Russian 5 Western.

UDC 523.5:531.42

Determination of the Masses and Densities of Meteoroids From Radar Observations From One Point

917Q0053B Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 24 No 4, Oct-Dec 90 (manuscript received 9 Jan 89; after revision 27 Mar 90) pp 326-332

[Article by P. Sh. Bibarsov, M. Narziyev, and R. P. Chebotarev, Institute of Astrophysics, Tadzhik SSR Academy of Sciences]

[Abstract] This article examines the location of the reflecting point on a meteor trail relative to the point of maximum ionization according to the results of radar

observations of meteoroids from five points and proposes a method which considers the processes affecting the shape of the ionization curve in determining mass and density from radar observations of meteors from one point. On average the reflecting point is 0.4 km below the point of maximum ionization. Equations are presented to calculate the mass of the meteoroid and correct for factors which affect the ionization curve. The density and mass of meteoroids can be calculated from the length of the meteoroid radio echo measured at one point or from radar observations from one point when the proposed method is used. Two methods of calculating mass are presented. For a meteoroid of mass 10^{-3}-10^{-1} g, density varies from 0.5 to 5.2 g/cm^3, with an average value of 1.9 g/cm^3. Figures 5; references 15: 11 Russian 4 Western.

UDC 613.693:629.78

Review of Primary Medical Results of Year-Long Flight on Mir Station

917Q0021A Moscow KOSMICHESKAYA BIOLOGIYA I AVIAKOSMICHESKAYA MEDITSINA in Russian Vol 24 No [illegible], Sep-Oct 90 (manuscript received 6 Jun 89) pp 3-10

[Article by A. I. Grigoryev, S. A. Bugrov, V.V. Bogomolov, A. D. Yegorov, I. B. Kozlovskaya, I. D. Pestov, and I. K. Tarasov; first paragraph given in English]

[Text] **The objective of medical investigations during and after the 366-day manned mission was to accumulate information about human responses to long-term effects of microgravity. To do this, cardiovascular and other systems were examined in detail during and after exposure. The results gave evidence that the crewmembers well adapted to the long-term flight effects. Their good health and high work capacity were supported by adequate medical procedures. Postflight readaptation developed similarly to what was seen after previous flights of shorter duration (six-11 months). No qualitatively new changes in the physiological systems were detected during or after this mission.**

During the period from 21 December, 1987, through 21 December, 1988, in the USSR, carried out on the Mir—Soyuz-TM—Kvant—Progress orbital complex was a year-long manned flight—the longest of all the space flights performed up to the present time. The crew of the year-long flight was made up of: V.G. Titov, the crew commander (K-1), and M.Kh. Manarov, the flight engineer (K-2).

In the course of the flight, the cosmonauts carried out joint operations with three international guest crews (Soviet-Bulgarian, Soviet-Afghan and Soviet-French), received five Progress supply ships and performed three spacewalks with a total extravehicular activity (VDK [EVA]) time of 13 hours 47 minutes. The medical support implemented during the flight included monitoring of the biosphere and the radiation environment; monitoring of the state of health and the realization of the prophylactic measures program; monitoring and regulation of the work and rest schedule; and the performance of medico-biological research during the flight and through its completion.

General Characterization of the Flight Conditions

Research conducted by A.B. Sysoyev et al. has shown that the habitability conditions during the flight were favorable and did not differ substantially from the conditions for the vital activities of the preceding crews on the Mir station. The atmospheric composition, the temperature and the humidity were maintained, as a rule, within an established, hygienically favorable range close to that of the earth's atmosphere. The occasionally noted increase in the overall pressure and the partial pressure of oxygen was associated with the performance of operations stipulated by the timing diagram for the operation of the life support system (pressurization, docking and extravehicular activities). Isolated instances, when the carbon dioxide's partial pressure exceeded 5-6 mm on the mercury column [mm Hg], were caused by the performance of intensive physical labor and certain technical experiments.

The sanitary chemical state of the gaseous atmosphere was characterized by the presence, within tolerable amounts, of organic substances related to a person's volatile metabolites and the products of gaseous emissions from nonmetallic materials (V.P. Savina et al.). Research on the sanitary microbiological state of the air, the surfaces of the interior and of the station's equipment revealed the presence of specimens of a person's automicroflora. On the whole, the station's condition, based on these readings, was characterized as favorable.

According to the data from research on the automicroflora of integumentary [skin] tissues, prior to the flight, the quantitative readings of the overall microbic infestation of the cosmonauts did not exceed the values typical for healthy people (A.N. Viktorov et al.). The intestinal microbiosis during the period of intensive preparations, just as before other flights, was characterized by the formation of dysbiotic deviations, the correction of which was accomplished by taking bifidum bacterin (N.N. Lizko et al.). In the postflight period, the state of the skin tissues' microflora was satisfactory. Pathogenic staphylococci and Gram-negative bacteria were not detected. The flight was not accompanied by an increase in dysbiotic changes; what were noted, however, were the expansion of the range of sensitivity to antimicrobic preparations, an increase in the level of bifidoflora and normalization of the ratio between bifidobacteria and intestinal bacilli [E. coli] while the level of lactoflora remained constant. The favorable condition of the intestines' microflora was apparently associated with the carrying out of measures to improve sanitary conditions.

The radiation environment over the extent of the entire flight was rated as calm. The total radiation exposure dose amounted to 12.2-14.0 rems or 7.6-8.7 rads (V.M. Petrov et al.).

The food ration, just as during the preceding mission, consisted of dehydrated, vacuum-packed dry food (65 percent) and canned goods with an average daily calorific value of 3,000 large calories.

The schedule for work and rest during the flight was planned on the basis of a 24-hour daily cycle with a work range of eight and a half hours, a sleep range of eight-nine hours and two days off per week. In the course of the flight, there were 14 shifts in the time for going to sleep on the average by four and a half-five hours, which were associated with docking with transport and supply ships and spacewalks. According to the crew members' reports, clockwise shifts were easier for them to endure than counterclockwise ones.

The prophylactic measures employed during the flight included twice-daily physical exercises on the veloergometer and the integrated "treadmill" exerciser, including using a set of expanders, and wearing the pressure suits (no less than eight hours a day). Also conducted in the flight's final stage was a cycle of exercises with the effect of negative pressure on the lower part of the body with vacuum values ranging from -10 to -45 mm Hg (V.M. Mikhaylov et al.). On the flight's final day, water and salt supplements were taken and, in the descent leg and the early postflight period, use was made of the Karkas [frame] bladderless-type anti-g suit developed by A.S. Yarov et al. The complete realization of the prophylactic measures program ensured the maintenance during the flight of the cosmonauts' good state of health, a high, professional work capacity and a good level of physical fitness. According to the data from the test with gradually increasing stress on the "treadmill" exerciser, both cosmonauts' physical fitness remained at the preflight level, while there appeared at the end of the flight a certain tendency for it to improve. This was manifested by an increase in the amplitude of the stress applied at the end of the test with a simultaneous reduction in the maximum heart contraction rate.

Results of the Research During the Flight

General Characterization of the Cosmonauts' Condition and the Anthropometric Research

Observations During the Flight. After the transition to zero gravity, both cosmonauts developed moderately pronounced sensations of the rushing of blood to the head and there appeared a swelling of the facial tissues and a nasal inflection in the voice. These sensations diminished over the course of the first few days of the flight and, for all practical purposes, did not have an effect on the work capacity. During the transition to zero gravity, one of the cosmonauts experienced the illusion of an inverted position (head downwards), while later, over the course of three days, while moving his head and making observations from a viewing port, he experienced the discomforting sensations typical of the initial manifestations of motion sickness.

During certain periods of the flight, both crew members noted toward the end of the workday a feeling of fatigue, which was relieved by a night's sleep. Episodes occurred of problems in falling asleep and of nocturnal awakenings. After EVA's, the cosmonauts noted painful sensations and a feeling of weariness in the arm muscles.

The State of Health and General Condition After the Flight. After the landing, the crew members were removed from the descent vehicle by representatives of the search-and-rescue service.

At the landing site and during the evacuation stages, the behavior of both crew members was sufficiently active. They displayed the capability of independent actions and could walk for a short time, although, at the same time, uncertainty in their gaits was noted. Their pulses under orthostatic and physical stresses were labile.

At the landing site, both cosmonauts complained of dizziness when changing the position of their heads, of the increased weightiness of their bodies and objects and of thirst. Symptoms of vestibulovegetative discomfort were not noted.

During the examination in the medical tent, the cosmonauts' condition was rated as satisfactory.

During the period of evacuation to the intermediate airfield, both crew members were in a horizontal position. However, the cosmonauts disembarked from the helicopter and boarded the airplane by themselves, with assistance from their escorts.

While being transported to the Cosmonaut Training Center in the airplane, both cosmonauts were noted as having very pale skin, which intensified and was accompanied by a tendency to perspire while in the vertical position, as well as lability in the hemodynamic readings.

Over the course of the first two days after the landing, the overall condition of both cosmonauts was satisfactory. One of them, just as during the flight, experienced the development of illusions (of the "heaving and rolling" type) and symptoms of vestibular discomfort, which were particularly acute during head movements in a lying position. Such a somewhat delayed development of vestibular dysfunction could be the result of the cosmonaut's excessive activity during the first few hours after the landing, when he rotated his head for the purpose of "vestibular conditioning." Subsequently, the condition of both cosmonauts was rated as good.

The Neural-Mental Sphere. According to the observations of the specialists (V.I. Myasnikov et al.), the state of the cosmonaut's neural-mental sphere was characterized by the presence of symptoms of asthenization, which were pronounced to a varying degree in different stages of the flight.

During the first month and a half of the flight, the crew members noticed fatigue toward the end of the day and disruption of sleep, which were viewed by the specialists as a consequence of the body's reorientation to the conditions of zero gravity and to the new stereotype of activities. In the second month, both cosmonauts occasionally complained about headaches, which were classified as a manifestation of vegetovascular dystonia and did not require any kind of treatment. The flight's fourth month was characterized by the cosmonauts' good state of health; in their own words, "it is like we have settled in." However, later on, the cosmonauts again complained periodically of difficulties in falling asleep and of superficial sleep; noted at times in their behavior was a rapid change of mood. These occurrences were most pronounced in the eigth and ninth months of the flights after the performance of a series of crucial operations (two spacewalks and the work with the two guest crews) and diminished in the ninth month after additional days of rest were granted. Some signs of asthenization also showed up during the last month and a half of the

flight—during the joint work with the Soviet-French crew, when the emotional stress increased again.

The psychoneurological status during the readaptation period was characterized by manifestations normally observed after prolonged flights. In the first few hours after the flight, the cosmonauts noted the increased weightiness of parts of their bodies and of objects and fatigability. At the same time, the specialists noted emotional lability, instability and inattentiveness.

The Anthropometric Research. Changes in the cosmonauts' body masses during the flight were not identical: one cosmonaut's mass had decreased by the end of the flight by 3.3 kg, while the other's had increased by 2.1 kg. These changes, apparently, were of an individual nature and did not go beyond the range of the fluctuations observed in other flights.

After the flight, during the examinations on the first, fourth and 16th days, the former showed a gradual decrease in the lost mass, which amounted respectively to 3, 2.7 and 0.5 kg, while the latter's excess mass began to go down by 2 and 2.4 kg.

The size of the shank decreased regularly during the flight and, by the end of the flight, its loss in both cosmonauts amounted to around 20 percent. Accordingly, during the postflight period, there occurred a pronounced decrease in the shank girths (-3 and -1.5 cm during the first day and -4 and -2 cm on the fourth day), which stayed the same until the 16th day (-2.5 and -1 cm). The arm and forearm girths during the same time did not change for all practical purposes.

Cardiovascular System Research

The Bioelectric Activity of the Myocardium. In both cosmonauts, the flight was accompanied by a decrease (in comparison with the average preflight values) in the amplitude of the *T* waves. The indicated changes did not go beyond the range of the physiological norm. On the day of the landing, it was noted that both crew members had a diffuse decrease in the overall amplitude of the *T* waves and an increase in the ratio of *QRS* to *T* against the background of an increase in the heart contraction rate (ChSS). Normalization of the *T* waves' amplitude and the *QRS/T* ratio was accomplished on the second-fourth postflight days.

On the day of the landing and the first day after the flight, during the examination of the dynamic EKG, a significant lability of the heart contraction rate was noted, with fluctuations ranging from 74 to 128 per minute for one crew member and from 70 to 178 per minute for the other. At the same time, recorded for Titov were 15 isolated right-ventricle monotonic extrasystoles and 12 isolated left-ventricle monotonic extrasystoles for Manarov.

Hemodynamics Under Resting Conditions. The heart contraction rate during the flight amounted to 56-73 per minute for Titov, corresponding on the whole to the values for the preflight fluctuations (55-68 per minute); the second and third months of the flight were an exception, when episodes were recorded of an increase in the heart contraction rate by 15-20 percent of the average preflight level (62 per minute); Manarov's heart contraction rate during the flight increased from 56-64 per minute (60 per minute on the average) in the preflight period to 63-79 per minute during the flight.

The heart stroke volume (UO) and the minute circulatory volume (MOK) for Titov over the entire length of the flight were less than the average preflight values by 13 and 10 percent; for Manarov, the beat volume value in individual measurements either was lowered by 13-21 percent, going beyond the range of the preflight values, or did not differ from the initial ground values; at the same time, the minute circulatory volume was, as a rule, elevated (by 15 percent on the average). The specific peripheral resistance (UPS) for Titov was characterized by an increase of 8-24 percent, while, for Manarov, as a rule, it was characterized by a decrease of 7-21 percent (in comparison with the preflight data).

The systemic arterial pressure (AD) in both cosmonauts changed within a small range. The regional hemodynamics, studied using the rheoplethysmography method, was characterized by an increase in the readings for pulse bloodfilling in the three main vascular sinuses of the head (the left and right internal carotid arteries and the vertebral-basilar system) with a simultaneous increase in the tonicity of the large vessels. At the same time, the vascular reactions were characterized by a primary decrease in the tonicity of the pre- and postcapillary sinuses of the right internal carotid (in Titov) and of the vertebral-basilar system and by the appearance on the rheoencephalogram of pronounced venous waves, which are a sign of a problem in the return of blood from the head region. In the sinus of the left internal carotid artery, the tonicity readings for the small vessels, as a rule, did not differ from the preflight values, which testifies to the normotonic condition of the pre- and postcapillaries. Thus, there occurred during the flight the development of interhemispheric asymmetry of the vascular tonicity, which was noted in preceding flights and in other cosmonauts. Also uncovered simultaneously were signs of an increase in bloodfilling of the lungs and the liver.

During the echographic examination, distinguished in both cosmonauts after the flight were a decrease in cardiac output, hyperkinesia of the interventricular septum and a moderate increase in the anteroposterior size of the right ventricle. The readings for the myocardium's contraction function, at the same time, stayed within the range of the physiological fluctuations. All the echographic readings on the fifth postflight day had normalized.

Ultrasound Examinations of the Internal Organs. Research conducted by V.S. Bednenko et al. on the 285th day of the flight detected in both cosmonauts a certain increase in the anteroposterior size of the liver

and a moderate increase in the bloodfilling of the lungs. These data were confirmed by the results of the postflight ultrasound examination which revealed in both cosmonauts an increase in the dimensions of the liver and the pancreas, in the height and thickness of the kidneys and the spleen and an increase in the bloodfilling of the lungs in the region of the lower lobes, while, in the vascular system, there were increases in the cross sections of the aorta, the superior mesenteric artery, the inferior vena cava and the portal and splenic veins, along with dilation of internal organ vessels—the hepatic and splenic veins. Changes in the condition of the pancreas in one of the cosmonauts were characterized also by the presence of signs of edema (a decrease in the acoustic density and sharpness of the echogram's lines). The degree to which the changes in the internal organs were pronounced decreased sharply by the 15th day of the readaptation period. The noted changes in the sizes of the internal parenchymatous organs are, apparently, a reflection of the congestive conditions which develop in them as a consequence of the realization of the unloading reflexes described by V.V. Parin, based on the type of dilation of the capacity vessels and the increase in the deposition of blood in them. The deposition of blood in the internal organs, in particular in the liver, spleen and lungs, can be viewed as an adaptive reaction which limits the influx of blood into the cardiopulmonary region and thus prevents the development of hypertension in the pulmonary circulation.

The Measured Physical Stress (DFN) Test on the Veloergometer. The measured physical stress during the flight was accompanied in both cosmonauts by heart contraction rates greater than those prior to the flight and, in Manarov, by a reduction in the stroke volume, which had increased during a test prior to the flight, and by certain changes in the minute circulatory volume, which expressed a tendency to decrease in Titov and to increase in Manarov (due to the increased heart contraction rate).

In comparison with the results of the preflight examinations, during the flight, while performing the tests, both cosmonauts had an increase in the heart contraction rate and Titov had a decrease in the stroke volume (by 11-23 percent) and in the minute circulatory volume (by 11-12 percent), while Manarov had practically no changes in the stroke volume and an increase in the minute circulatory volume (by 16 percent). Changes in the arterial pressure were characterized by a decrease, somewhat more pronounced than prior to the flight, in the diastolic arterial pressure and, in a number of tests, by an increase in the average dynamic arterial pressure (by 8-12 mm Hg) and the final systolic arterial pressure (by 16 mm Hg on the average). At the end of the flight, the changes in the arterial pressure readings during a test approached the preflight level.

The cited data testify to a certain increase in the degree to which reactions to measured physical stress during the flight are pronounced. The moderate nature of the uncovered deviations made it possible to rate the tests' endurability as good. As the same time, however, the nature of the adaptive reactions changed, which was manifested in a decrease, more pronounced than prior to the flight, in the peripheral resistance (a lowering of the maximum arterial pressure), which ensured an increase in the capacity of the vascular channel and a rise in the energy of the cardiac output (an increase in the final systolic arterial pressure).

The Test With Application of Negative Pressure to the Lower Part of the Body (ODNT). During the flight, under the action of negative pressure on the lower part of the body, both cosmonauts' heart contraction rate increased to a level somewhat greater than the preflight level: this effect was more noticeable in Manarov. The arterial pressure changes were manifested in Titov by a final systolic pressure decrease greater than prior to the flight. In Manarov, during two tests, a change was noted in the adaptive reactions, which was manifested by a decrease, more pronounced than prior to the flight, in the pulse pressure (from 40 to 14 mm Hg and, prior to the flight, to 23 mm Hg), or by an increase in the diastolic arterial pressure (up to 80 mm Hg and, prior to the flight, up to 68-73 mm Hg), with a simultaneous increase in the heart contraction rate (up to 90-98 per minute and, prior to the flight, up to 86-88 per minute).

Postflight Examination of Orthostatic Stability. Both cosmonauts' orthostatic stability during the first few postflight days had decreased. In Titov, on the first and second days, the endurability of the active orthostatic test was rated as satisfactory and it was only on the fourth day that it was rated as good. In Manarov, the test's endurability had also decreased on the second day and rated as quite satisfactory on the fourth day after the flight.

The readings for the passive postural test conducted on the fifth-seventh days after the flight corresponded to the level of satisfactory endurability for both cosmonauts. During an examination on the 16th day, for one of the cosmonauts, it was good (although it was lower than the preflight level), while the other's remained satisfactory.

The Results of the Research During EVA's. During the year-long flight, three spacewalks were performed: on the 67th, 192d and 304th days of the flight.

During the EVA's, the total energy expenditures for Titov and Manarov amounted respectively to 890-1250 and 920-1320 large calories with average energy expenditures per minute of 3.4-3.9 and 3.4-4.0 large calories and their fluctuations ranging from 1.9 to 6.0 and from 1.8 to 6.8 large calories. At the same time, the primary physiological readings for Titov and Manarov respectively fluctuated within the following ranges: heart contraction rates of 68-122 and 72-128 per minute and a parotid temperature of 35.9-37 and 34.5-36.5 degrees C (A.S. Barer, T.V. Batenchuk-Tusko et al.)

Deviations in the physiological readings, which indicate a deterioration of the state of health, were not recorded during the EVA's, with the exception of signs of a pronounced weariness of the arm muscles during the

second spacewalk, which was associated with their prolonged stress while holding the body at the work site. The use of additional holding means during the third spacewalk was accompanied by a decrease in the degree of weariness of the arm muscles, despite the high intensity of the work.

Research on the Motor Sphere. Research on the afferent components of the motor system, conducted on the fourth and fifth days after the flight, did not reveal substantial changes in the activity of the afferent systems. The vibration sensitivity thresholds of the foot's support areas were within the range of the preflight values. The thresholds for the (Achilles') tendon T-reflex were close to the initial values, however, the reflex' maximum amplitude exceeded the initial one by a factor of more than three; it remained elevated also on the seventh-ninth days.

The isokinetic dynamometry test performed on the eigth postflight day did not reveal in either cosmonaut a pronounced hypotrophy of the anti-gravity muscles: the load-bearing responses of the shank triceps under load-bearing and isometric conditions after the flight exceeded the initial values by 16 percent (in Titov) and 36 percent (in Manarov). The exception was at high speed (180 angular degrees per second), in which the load-bearing readings for both cosmonauts were distinctly depressed (by 54 percent). The tibialis anterior muscle suffered to a greater degree during the flight, the load-bearing losses in which under all testing conditions ranged from 23 to 59 percent. The working capacity of the shank muscles was substantially reduced (by a factor of more than 4) in both cosmonauts after the flight.

Research on the responses of the activities of the movement control systems detected in both cosmonauts signs of the coordination impairments typical for prolonged flights, however, the degree to which they were pronounced, according to a number of readings, was not as considerable as during flights of shorter duration. In the stabilographic research, the vertical stability readings (the amplitude and rate of fluctuations and the electromyographic cost of maintaining a vertical position) for both cosmonauts did not differ substantially from the preflight ones, with the exception of a small increase in the scope of the fluctuations for the general center of gravity (by 50 percent in Titov and 11 percent in Manarov) and the lobe on the stabilogram for tremor-type high-frequency fluctuations. More distinct changes were recorded in the parameters of the reactions to disturbances of the body's equilibrium, which testify to the presence of coordination impairments (a decrease in the thresholds for the posture correction responses to a disturbance and an increase in the posture recovery time and in the electromyographic cost of vertical standing). However, even in this instance, the change values were small.

In both cosmonauts after the flight, there were impairments in the precision control of voluntary movements (dysmetria). In the effort step test, the number of correct responses for one of them amounted to only 40 percent (100 percent prior to the flight); the number of distinguishable effort steps decreased to 50 percent. In the rapid gaze adjustment test, the number of errors with subsequent correction in both cosmonauts rose to 50 percent (the norm is 3-5 percent), while, with optokinetic stimulation, it rose to 75 percent (the norm is 15-18 percent). By the 14th day of readaptation, the degree to which these impairments were pronounced decreased substantially, however, the precision of the reactions remained substantially deteriorated.

The flight was accompanied by profound changes in the parameters for the gaze adjustment reactions, which reflected the processes which develop in zero gravity of behavioral and neuroreflex adaptation in the control systems for combined coordinated movements of the head and eyes. In the research performed on the 4th postflight day, noticed in both crew members was a distinct retardation of head movements and, as a consequence of this, an increase in the contribution of saccadic eye movements to gaze adjustment (behavioral adaptation). Uncovered simultaneously were profound changes in the vestibulo-ocular reflex coefficient—a substantial decrease in Titov (to 0.63) and an increase in Manarov (to 1.29), which point to a retardation of the vestibulo-oculomotor transmission in the former and its facilitation in the latter (neuroreflex adaptation).

Thus, the year-long flight caused the development in both crew members of changes in various components of the motor system, which are typical for the hypogravity syndrome, however, the intensity of the majority of them was slight. The greatest deviations caused by the flight were in the activities of the movement control systems: signs of hypogravity ataxia remained in both crew members over the course of more than two weeks after the flight, however, even the ataxic impairments were not as pronounced in this flight as after flights of shorter duration (180-237 days).

The State of the Vestibular Function and the Sensory Systems Which Interact With It. Research performed during the first few postflight days (L.N. Kornilova et al.) uncovered in Titov a rise in vestibular reactivity and an increase in oculomotor activity. In the vertical and inclined positions of a cosmonaut with eyes diverted sideways, adaptive nystagmus was recorded. In Manarov, the signs of vestibular dysfunction were more pronounced. During the first few days, a negative otolithic reflex was recorded in him and, with all positions of the body in vertical and horizontal diversions, a low-amplitude, low-frequency nystagmus, bent in shape, which intensifies when the eyes are open. Rocking movements by the head were accompanied by considerable sensory and vegetative reactions. Repeated examinations performed on the fifth and 15th postflight days revealed in both crew members distinct positive dynamics.

The Bony Tissue. The postflight research on the bony tissue, performed by V.S. Oganov et al., uncovered in

Titov (according to the data from the quantitative computer tomography) a decrease in the mineral density of the spongy tissue of the lumbar vertebrae. Just as after the 150-day flight, the degree to which this decrease was pronounced increased from the first to the third vertebra and amounted respectively to 8, 10 and 12 percent (10 percent on the average). In Manarov, who was examined using the double-photon absorptiometry method, the mineral density in the studied sections of the skeleton increased somewhat (by 5.2 percent on the average).

Research on the Metabolism. Research, performed prior to the flight and afterwards on the first and seventh days after the flight by I. A. Popova et al., revealed in both cosmonauts changes in the metabolisin readings, which were, as a rule, of a unidirectional nature. In connection with this, in a subsequent report, with the exception of specially stipulated instances, the data for both cosmonauts are presented in a generalized format.

The Protein-Nitrogen Metabolism. Noted in both cosmonauts after the flight was a decrease in the blood's content of [a–] and [g–]globulin fractions of protein with a simultaneous increase in atherogenic globulins, which presupposes a decrease in the liver's biosynthesis activity. Noted at the same time was a decrease in the blood's creatinine and uric acid content, which had not normalized by the seventh day after the flight. An individual feature of the changes in Titov was a small increase in the blood's general protein and albumin content with a decrease in the urea content, while, in Manarov, there was a decrease in the protein level with some increase in the albumin and urea content.

The Carbohydrate Metabolism. The blood's glucose and lactate content during the first postflight day had increased to the values of moderate hyperglycemia; also increased in Titov was the pyruvate content. Normalization of the glucose level (without complete restoration of intermediate metabolism's readings) ensued by the seventh day.

During the flight (on the 321st and 332d days) and after it (on the 15th day), according to the data of K.V. Smirnov et al., changes were uncovered in the nature of the glycemic curve during the glucose tolerance test. In Titov on the 321st day of the flight, the hyperglycemic curve was depressed, without a noticeable rise in the glucose level after stress. During a study on the 332d day, a tendency was noted toward normalization of the glycemic curve, although the rise in the glucose level did not reach the preflight value, while recovery of its excess from the blood occurred slowly—over 120 minutes (over 60 minutes prior to the flight). In Manarov, the glycemic curve on the 321st day was similar to the preflight one, however, on the 332d day, it decreased and became double-peaked in nature. During an examination on the 15th postflight day, the blood's glucose content after 30 minutes of stress in Titov exceeded somewhat the preflight level. In Manarov, the glycemic curve did not differ from the initial one.

The Lipid Metabolism. A study of the blood's triglyceride content during the first postflight day revealed a tendency toward their decrease in combination with a considerable increase in the concentration of free fatty acids. On the seventh postflight day, the blood's triglyceride level had normalized, while the free fatty acid content continued to remain elevated. Also reduced in the blood plasma was the linoleic acid level, while the arachidonic acid concentration increased. In the lipids of the erythrocytes' membranes, the arachidonic acid content during the first day was also elevated and, by the seventh day, it had normalized.

Blood Serum Enzymes. Uncovered in the blood serum during the first postflight day was a decrease in the activity of isocitrate dehydrogenase and the general activity of malate dehydrogenase and its mitochondrial isozyme, MDG_3 [MDH_3], while the decrease in the activity of both Krebs-series dehydrogenases was more pronounced than after other prolonged flights. Also observed simultaneously was a decrease in the lactate dehydrogenase level. The increase uncovered during the postflight research in activity due to the muscle fraction (MM isozyme) creatine phosphokinase (by a factor of nearly 4 in Manarov), also noted previously after other prolonged flights, is probably a result of the increased stress during the readaptation period (in comparison with zero gravity) on the skeletal muscles. The increase in the functioning of the bone cells under the influence of the rediscovered action of terrestrial gravity apparently also explains the increase in the activity of the alkaline phosphatase, mainly due to a threefold increase in the amount of the bone isozyme. Also noted in Titov was an increase in the activity of the acid phosphatase. The activity of aspartate aminotranspherase in both cosmonauts' blood decreased, while, in Titov, this decrease was especially considerable (by a factor of 4). A similar decrease was recorded also after prolonged antiorthostatic hypokinesia.

The majority of noticed deviations had leveled off completely or partially by the seventh day after the flight.

The Erythrocytes' Metabolism. During a study on the seventh postflight day (S.M. Ivanova), noted in Titov was a tendency toward activation of the metabolic processes in the erythrocytes. At the same time, there occurred in Manarov a significant decrease in ATF [ATP] and reduced glutathione against the background of an increase in the intensity of the energy-producing process—glycolsis, which may be the result of the increased expenditure of this nucleotide in connection with the changes in the activity of the membrane processes. This assumption finds support in the changes discovered in this same cosmonaut in the activity of Na, K-ATP and Ca-ATP, in the decrease in the cells' capacity and deformability and in the increase in their resistibility to acid hemolysis.

On the 70th day after the flight, the readings for the erythrocytes' metabolism corresponded to the physiological norm. However, the activity of Na and K-ATP in

both cosmonauts was depressed; noted simultaneously in Manarov was a decrease in the cells' resistibility (a deviation in the erythrogram to the left). It should be noted that, during all the examination periods, the potassium and sodium content in the erythrocytes did not change, pointing to the absence of significant impairments in the cellular membrane's permeability.

Thus, the year-long stay in zero gravity caused in the cosmonauts the development of deviations in the erythrocytes' metabolism and the functional condition of their membranes, which apparently reflected the cell's adaptive reactions, were of an individual nature and depended on the body's physiological condition, nourishment and the volume of prophylactic measures. Similar changes were recorded under the conditions of the 120- and 370-day anti-orthostatic hypokinesia.

The Water-Salt Metabolism. During the final day of the flight, the fluid balance in both cosmonauts differed only slightly from its preflight level. Subsequently, on the first postflight day, both cosmonauts retained body fluid and there was a decrease in the excretion of osmotically active substances and sodium by the kidneys. At the same time, there were no substantial changes in the excretion of bivalent ions with the urine. Noted in both cosmonauts' blood serum was an increase in the ionized calcium concentration and, in Titov, a decrease in the potassium content (to the lower limit of the norm). All the noted deviations, with the exception of the increased activity of Titov's ionized calcium, leveled off by the seventh postflight day.

As indicated by the results of the calcium load test (V.B. Noskov) performed on the 42d postflight day, the calciuretic function of the kidneys changed in the cosmonauts in different ways: the rate of excretion of calcium with the urine in Titov exceeded that prior to the flight (122 percent versus 111 percent), while it was distinctly less in Manarov than prior to the flight (150 percent versus 215 percent).

On the whole, the changes in the kidneys' functional condition, which were observed after the year-long flight, apparently reflected the adaptation restructuring of the hemodynamics and the water-salt metabolism and did not go beyond the range of the fluctuations noted previously after space flights of shorter duration.

The Endo tem. Research performed on the first and sever ight days (I.M. Larina et al.) revealed a series of ..nsistent changes in the endocrine system's activities.

The state of the pituitary-adrenal system was characterized by a discrepancy between a more than 10-fold increase in the adrenocorticotropin (AKTG [ACTH]) concentration in the blood plasma and slight changes (in Titov, a decrease and, in Manarov, an increase) in the cortisol [hydrocortisone] concentration, which may reflect a reduction in the sensitivity of the adrenal glands' cortex to ACTH. On the seventh day, the blood's ACTH concentration had a tendency to decrease, however, even on the 70th day, it had not reached the initial level. Somewhat depressed (against the background of an increase in the thyroxin level) during the first day was the blood's thyrotropic hormone concentration.

In the sympathetic adrenal system (SAS), during the early days after the flight, there occurred an increase in the activity of its hormone component: noted during the day of the landing was a rise in the excretion of epinephrine, which occurred against the background of a decrease in the excretion of norepinephrine, dopamine, normetanephrine and vanillylmandelic and homovanillylmandelic acids; during the first postflight day, a considerable increase was observed in the blood's concentration of epinephrine and norepinephrine. All the noted changes remained even on the seventh day of the readaptation period.

Just as after a number of other flights, the level of group E prostaglandins in both cosmonauts decreased markedly; this decrease was also recorded on the 70th postflight day. The concentration of group F_2 prostaglandins during the first day, on the other hand, increased. However, subsequently (on the 70th day) their concentration dropped sharply.

Despite the increase in the activity of the SAS, the blood plasma's content of cyclic nucleides did not differ significantly from the preflight level, which indirectly points to a decrease in the activity and/or number of adrenergic receptors.

A study of the hormones which regulate the water-salt metabolism revealed during the 1st postflight day an increase in the blood's ADG [ADH] level (by a factor of two-three) with an absence of changes in the activity of renin and in the concentration of aldosterone. However, by the seventh day, the aldosterone concentration increased, which apparently reflected the water-salt metabolism's process of adaptation to ground conditions. The described dynamics of the hormones which regulate the exchange of sodium and water pointed to a more rapid restoration of the water losses and a slower restoration of sodium.

In Manarov during the seventh day after the flight, an increase was noted in the blood's insulin content. The somatotropin concentration in both cosmonauts was below the method's sensitivity threshold. The blood's concentration of calcitropic hormones in Titov did not change. In Manarov, the blood's concentration of parathyroid hormone during the first-seventh postflight days was elevated, while the calcitonin concentration had decreased; this decrease remained even longer (on the 70th day).

The activity of the cholinergic system's enzymes, which inactivate acetylcholine, was characterized after the flight by low-amplitude fluctuating processes which apparently reflect the processes of the body's adaptation to ground conditions after a prolonged stay in zero gravity. At the same time, the activity of the histaminergic and serotoninenrgic systems during the postflight

period increased sharply. The activation of the serotoninergic system may be viewed as a compensation reaction which facilitates the diluting of deviations in the body's various systems; at the same time, the activation of the histaminergic system may point to the postflight development of symptoms of the body's allergization. The noted changes in the activity of the mentioned systems in both cosmonauts remained even on the seventh postflight day. During subsequent research, the values for the studied readings, which characterize the metabolism and its regulating systems, almost reached the initial level.

The Blood System. A clinical analysis of the blood, performed by the doctor cosmonaut during the second half of the flight, showed that the hematological readings (the number of erythrocytes, reticulocytes and other formed elements) in both cosmonauts remained within the range of normal values. However, in Titov, there was a one-time recording of eosinophilia, which occurred also prior to the flight, while, in Manarov, in one of the analyses (on the 270th day of the flight), a slight leukoneutropenia was noted.

After the landing, detected in the peripheral blood of Titov and Manarov were decreases in the number of reticulocytes (by 69.3 percent and 43.1 percent respectively), in the numbers of erythrocytes (by 170,000 and 540,000) and in the mass of the hemoglobin (by 11 percent and 12.1 percent respectively), as well as anisocytosis, which was also observed previously after flights of shorter duration (V.I. Legenkov). Subsequently, over the course of the first week of readaptation, against the background of an increased intake of fluids and the elimination of signs of hypohydration, there occurred a further uniform decrease in the red blood readings, whereby the hematocrit dropped by 6-8 percent. The reticulocytopenia noted right after the end of the flight was replaced during this period by a gradually increasing reticulocyte reaction.

The Immune System. As has been shown by the research performed by I.V. Konstantinova et al., the changes in the readings for immunologic reactivity after the year-long flight consisted of a moderate decrease in the FGA [PHA] activity of the T-lymphocytes (a decrease in the content of cells with a high rate of RNK [RNA] synthesis from 23.2-25.2 percent before the flight to 12.8-14.0 percent after the flight with a lower limit for the norm of 15 percent), suppression of the proliferation of T-lymphocytes in PHA cultures (the number of cells marked by ^{3}H-thymidine [tritiated thymidine] decreased by a factor of 1.9-3.2) and a decrease in the lymphocytes' output of the most important mediator of cell immunity—interleukin-2, which supports the growth of T-lymphocytes and increases antibody production.

The readings for antiviral resistibility, the blood's content of immunoglobulins and the production of [a–] and [g–]interferon by the lymphocytes in both cosmonauts remained at a high level.

All the uncovered changes normalized over the course of a week. However, in one of the cosmonauts, even two months after the end of the flight, the number of T-helpers, which activate the immune response, remained depressed.

Conclusion

The year-long flight of V.G. Titov and M.Kh. Manarov is an important stage in the development of the manned space program. Its accomplishment became possible thanks to the realization of a broad set of systematic scientific studies and the solving of a number of problems in providing medical support for prolonged flights.

The results of the medical and biological research performed during the flight and after it testify to the maintenance in the cosmonauts over the course of the entire flight of a good state of health and an adequate work capacity. Upon the completion of the flight, the cosmonauts satisfactorily endured the effect of gravity. The course of the readaptation processes was favorable in them and did not differ on the whole from that after flights of shorter duration (six-11 months). During the flight and after it, no qualitatively new deviations were uncovered in the functions of the body's primary systems. Changes in the activities of a number of systems (motor, cardiovascular, skeletal and others) were even less profound than after other prolonged flights.

At the present time, the state of health of V.G. Titov and M.Kh. Manarov meets the criterion of fitness for participation in future space flights.

Limited Current Capabilities for Cosmonaut Rescue

91Q00154 Moscow NTR TRIBUNA in Russian No 15-16, 1990 (Signed to press 9 Sep 90) p 14

[Article by O. Burluka and D. Dmitriadi, the Cosmonaut Training Center: "The Rescuers Are the Cosmonauts and the Ships"]

[Text] A recent incident in space—the damage to the thermal insulation of the Soyuz space ship—for the umpteenth time, has compelled us earthlings to be anxious about the fate of cosmonauts. I know that something similar happened previously as well. One of the leaders of our space program said in an interview on the program Vremya that there is some kind of system for rescuing cosmonauts involved in a calamity. He did not go into more detail about this system and, therefore, I am turning to your newspaper on this matter.

[Signed] M. Nalivayko, Severodvinsk

For a start, we will try to outline the "ideal" scheme for a rescue operation in space. In any stage of a space flight—right after insertion into orbit, during the ship's autonomous flight or when it is docked with an orbital complex and, finally, before the return to the ground—it should be possible over the course of a few hours to launch an "emergency service" ship with a skilled cosmonaut on board, who is able to render assistance to his comrades in the event of their sudden illness, in eliminating problems on board or, in exceptional cases, in returning them to the ground using the rescue ship. Such, we reiterate, is an ideal scheme. But what do we actually have?

First of all, regarding the rescue ship. It, as it turned out, simply does not exist. There is a Soyuz TM-type series-production ship which is readied in parallel with the one going into space. At a specified stage, the "backup" is stored. By the next launch, it is prepared now as the primary ship, while the one which follows it in the production chain takes its place.

Such an approach immediately limits the possibilities for conducting rescue operations. The time needed for reactivation of the "Soyuz-in-waiting," in the words of Vladimir Shatalov, head of the Cosmonaut Training Center, is around 10 days. But even if the ship itself is ready for a launch, all the same, around a day is needed to mate it with the launch vehicle, to move it out to the launch pad, to fuel it up and so on. The last figure is generally not too "terrible," because it takes up to 24 hours for the orbital plane of a vehicle involved in a calamity to pass over the cosmodrome and for the rescuer to be able to "catch up" with the rescuee (although it is obvious that operational efficiency in reacting to unusual situations is significantly reducted).

What is worse—the Soyuz-TM as a rescue vehicle can carry out the evacuation of cosmonauts neither at just any stage of the flight nor with just any complement. Not at just any stage because, up till now, there are no ships with a so-called "passive" docking assembly—a "funnel" capable of docking with an active transport Soyuz, not with just any complement because the ship, as before, is a three-seater and, during the evacuation of the cosmonauts, there is no seat left for the rescuer himself! The chances of docking an unmanned ship with its "brother," which may have a damaged attitude control or rendezvous system, are close to zero. So that if a tragedy occurs in the autonomous leg of a flight, the fate of the cosmonauts is unenviable: the Soyuz-TM's useful operating life amounts to four days, while the ship's life expectancy (i.e. the time over which there occurs passive deceleration of the ship by the upper layers of the atmosphere) is around half a year.

However, for the sake of fairness, it must be noted that whereas the majority of a ship's systems are backed up, the systems associated with life support and the return to the ground have three backups.

The situation with the specialized group for training cosmonaut rescuers inspires great optimism. It is usually made up of five or six of the most experienced cosmonauts. The training in such a group, as Vladimir Titov, one of its participants, recounted, differs to a great extent from the basic training. The future rescuers are taught to function as two people—the commander and the flight engineer, hence, special attention is paid to trying various dynamic operations: rendezvous, approach and docking, attitude control and descent in manual mode.

It would be incorrect to think that all the cosmonaut rescuers are constantly expecting their "own" launch during the flight of any crew. Each specific crew is watched over, as it were, by a specific rescuer. It is precisely this one who is supposed to be in excellent shape and always ready for a launch. The remaining cosmonauts relax or go through training as part of the ordinary crews.

Now the hope has appeared that the pessimistic picture drawn here will change for the better in the near future. Vladimir Solovyev, the Mir complex's flight supervisor, said in a conversation with the authors of this article that, in the coming year, a launch has been planned of a newly modified version of a Soyuz. The basic difference between it and the previous vehicles will be an androgynous docking assembly capable of operating in the role of both a passive and an active assembly. Incidentally, the Kristall module, which was made fast to the Mir's "moorings" two months ago, is designed to receive a ship with such an assembly, with which the Buran will also be equipped. This news, in and of itself, is good, but... for all practical purposes, this very same docking assembly had been tested in space 15 years ago, during the joint Soyuz-Apollo flight. "What, then, hindered its incorporation for so many years?" is a question we put to our interlocutors. They cited the foreign political reasons and the difficulties which arise because of the assembly's more than 100-kg weight. However, the impression arose

that what was at fault here was our chronic illness—the lack of both ability and desire to employ on a timely basis the fruits of the labor of our own developers and designers.

The remaining plans were imparted to us with the words "it would be good": it would be good to have a ship designed for a larger number of cosmonauts—the two for Mir is already insufficient; it would be good to have on board the rescue ship specialized equipment for rendering medical, repair and reconditioning and other assistance and even a somewhat larger hatch so it would be possible to transfer from one ship to another in a space suit; it would be good, finally, to have at a launch not a "temporary" rescue ship, but rather, so to speak, a permanent one. All these "it would be good's" rest, for the time being, on the financial obstacle.

Meanwhile, in the capital of Saudi Arabia, Ar-Riyadh, in the fall of last year, a routine congress of the Association of Space Flight Participants took place, which was specially devoted to the problem of rescuing cosmonauts. The interest in this throughout the entire world is of no surprise: by the year 2000, there will already be in orbit, apparently, two permanently operating orbital complexes—Mir-2 and Freedom, while the number of cosmonauts simultaneously on board them will exceed 20 people. The use of "space shuttles" like the [U.S.] Space Shuttle and Buran as rescuers is still problematic: the launch preparation time for them is even greater, although the capabilities are also broader. The turning point, apparently, will come when these types of ships will be capable of being launched from special carrier aircraft. But this is a matter of the relatively far future. But, for the time being, the main hopes are being pinned on the International Cosmonaut-Astronaut Rescue System, a principle role in which should be played by our "workhorse"—the Soyuz ship. Of course, in addition to the standardization of docking assemblies, still to be solved is a mess of problems, but, in the words of that same V. Titov, they are somewhat simpler to solve.

And so, we will hope that the difficulties associated with rescuing cosmonauts will be solved (even if with international participation) in the near future. For now, the cosmonauts have to be guided by the principle borrowed from I. Ilf and Ye. Petrov: "The rescuing of drowning people is a matter for the hands of the drowning people themselves."

Lozino-Lozinskiy Advocates 'Molniya' Air-Launched Spaceplane

907Q0156 Moscow PRAVDA in Russian 1 Sep 90 Second Edition pp 1, 2

[Interview with Gleb Yevgenyevich Lozino-Lozinskiy, doctor of technical sciences, chief designer, general director of NPO Molniya, Hero of Socialist Labor, and recipient of the USSR's Lenin Prize and State Prizes, by PRAVDA correspondent A. Tarasov, under the rubric "Science Fiction on the Drawing Board": "Will We Fly on 'Molniya'?"; first paragraph is source introduction]

[Text] **Doctor of Technical Sciences G. Lozino-Lozinskiy, chief designer, general director of NPO Molniya [Molniya Scientific Production Association], Hero of Socialist Labor and recipient of the USSR's Lenin Prize and State Prizes, talks about the development of a new, reusable aerospace plane.**

[Tarasov] Gleb Yevgenyevich, your NPO, as is well known, developed the airframe of the Buran reusable ship and, it is generally acknowledged, did so brilliantly. And even though that remarkable ship remains idle, without any work, you have, without taking a breath, proceeded on to the next such development. What is the reason for that?

[Lozino-Lozinskiy] The reason is that the basic cargo flow and transport support of the present-day orbit require a more economical means than the superpowerful Energiya-Buran system. At the same time, it should be more mobile, flexible and general-purpose than the expendable launch vehicles. Ninety percent of the American vehicles and 70 percent of the Soviet vehicles carry as much as seven tons. All the orbital aircraft planned by foreign countries are also being geared toward that lift capacity.

Also needed, of course, are more powerful means for orbital insertion, but for loads which are launched relatively infrequently. Based on serious economic grounds, that also justifies the use of powerful expendable rockets.

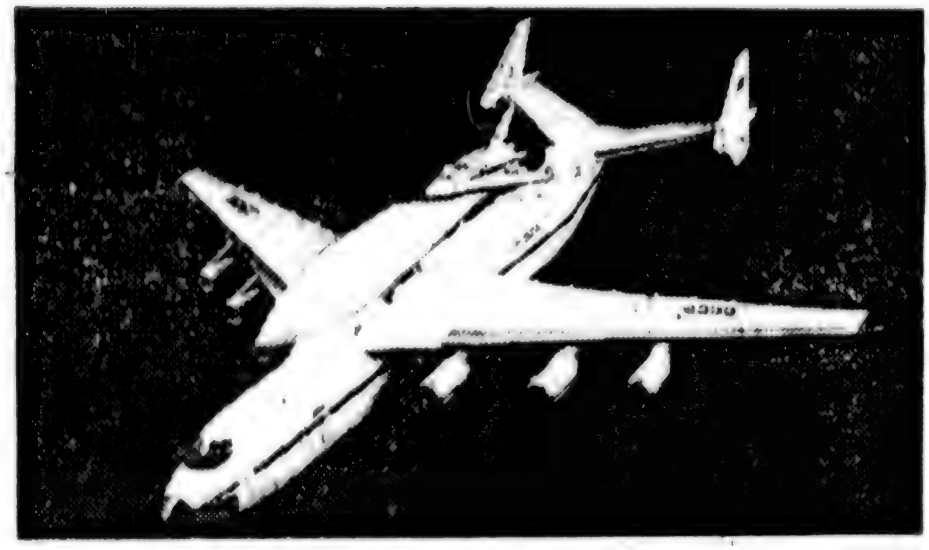
But I haven't the slightest doubt that, for most of the launches in the future, we should use reusable systems, which will, in the end, actually reduce the cost of inserting a single kilogram of payload by a factor of 5-10.

[Tarasov] To put it another way, a powerful crane like the Energiya or the Proton is required to lift a space home into orbit, while an economical express elevator should be used for exchanging routine loads...

[Lozino-Lozinskiy] Something like that. Our "elevator" will be capable of replacing virtually all the rockets with a lift capacity of up to 15 tons.

I would remind you that the Soyuz launch vehicle lifts a spacecraft that weighs seven tons. That's nowhere near a payload. It's considerably smaller. The Molniya aerospace plane, which weighs 24 tons, is launched, as if from the first stage of a rocket, from the Mriya transport carrier aircraft. And the Molniya will only carry a payload of, again, seven tons--eight tons in the unmanned version.

With true reusability, each launch preserves for us not only the extremely complicated and very expensive electronics of the control system, which perish in expendable rockets, but also the engine itself—now, unlike with Buran, it will be attached to the space plane. Only the expendable external fuel tank is lost.



But those are not the only savings. The right-of-ways needed for test-range launches become unnecessary. There are no intermediate stages and the tank remnants always fall into the ocean.

What substantially reduces the cost and simplifies the use of the aero-space plane is that we can use existing airfields if we modify them.

Finally, about one of the decisive advantages of a mobile horizontal launch. Remember how rigidly the expendable rockets are tied to the orbits. In order to send a vehicle into the necessary plane for docking with a vehicle that is already about a rocket may have to wait for hours or days.

But now imagine that the cosmodrome—it will be the Mriya carrier aircraft—will be rapidly moved by 1,000-3,000 kilometers, and by 8,000 kilometers in the future, as it meets up with a flying satellite in an orbital revolution which is closest in terms of time. Any emergency situation urgent repair or rescue can be taken care of truly rapidly. That is why we are also proposing the establishment of an international emergency rescue service based on the Mriya.

Thus, a reusable aero-space system is capable of performing all the present-day transport and cargo operations in support of an orbital complex, providing it a full-fledged "feedback" efficiency. It is capable of servicing future orbital automated points that produce highly pure mechanics biological preparations semiconductor crystals and alloys.

And finally, a passenger variation of the airplane, seating several people, is also possible. In suborbital flight at considerable kilometers it can cover minutes. The cost of a ticket, we think, would not be more than several rubles. And hardly would space tourists several rubles around the Earth.

[Tarasov] One question comes to mind. Shouldn't we have developed that system first as a more essential system, and only then move on to Buran?

[Lozino-Lozinskiy] We had actually begun such development back in 1965 when we were part of Academician Mikoyan's experimental design bureau. Unfortunately, we were not given support, and in 1976 that research area was dropped. It took several more years for the country's leaders and those of the space sector to return to the idea of reusability, but this time it went along the lines of the American model on the basis of the powerful Energiya launch vehicle.

But don't be in a hurry to write off. Because [illegible] necessary for the construction of a heavy-space vehicle.

Indeed, the work on Buran gave us [illegible] and helped us to achieve a new level of technology and mathematical design methods and to produce new materials that we had not even dreamed of in the 1960's. The Mriya AN-225 carrier aircraft was developed, which is capable of lifting an aero-space plane into the air and delivering it to a launch site. Without Buran there would not even have been a Mriya as the space for the new development.

The prototype of the Mriya itself has been tested. It's the scaled-down model of Buran that was split up for thermodynamic tests as Kosmos 1374, 1445, 1517 and 1614. So, thanks to Buran, many stages of the new development have been completed.

But you are right with respect to the public over the last 10-15 years, unfortunately, the exploration of space has not had the needed scientific leadership. That has led to the discrepancy between payloads and the capabilities of the Buran craft and its actual program.

[Tarasov] When could the Mriya be launched?

[Lozino-Lozinskiy] With the necessary financing, I believe it could be done as early as 1996. In order for you to get an idea of our problems, you should know that the Mriya, for example, will no longer be the same Mriya tht lifts only a 200-ton load to a given altitude (the overall launch weight of the system is 600 tons). Now it has to carry within itself an entire launch complex that, on the ground, is serviced by hundreds of people. Accordingly, dimensions have to be reduced and the equipment has to be automated to the maximum possible extent. That's an enormous task for the developers of the new equipment and of even lighter and more durable materials. In brief, the developers of each instrument and each assembly for the Mriya and the Molniya are facing interesting and complicated problems.

International cooperation is opening up large opportunities. After my report on the routes being taken in the development of aerospace systems at the 40th Congress of the International Astronautical Federation in Malaga (Spain), in October 1989, the English company British Aerospace came out with the idea of using our Mriya carrier to put into orbit its own version of an aero-space plane, the Hotol, which weighs 250 tons.

The Europeans and the Japanese are currently engaged in the development of reusable winged systems. It would be a great pity if, because of the usual sluggishness and lack of coordination, we again find ourselves at the tail end of the process and, as a result, are again without an economical and efficient aerospace transport vehicle developed in a timely fashion.

Kristall Module's New Features Detailed

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[Article by V. Syromyatnikov, section chief at the Energiya Scientific Production Association, doctor of technical sciences: "APAS and the New Class.: The Kristall Module: We Report on the Details"]

[Text] **Among its creators, the Kristall long-term orbital module is called simply by its technological abbreviation—"T." In contrast to the earlier Kvants it is equipped with electromechanical units and systems, two of which are fundamentally new.**

First of all it is necessary to talk about a fundamentally new type of additional docking unit. It is a modified APAS—androgynous peripheral-type docking assembly.

This almost-forgotten mythical space term was coined in the early 1970's when the first international manned space project was being planned. It culminated in the successful docking of the Soviet and U.S. Soyuz and Apollo space vehicles in July 1975.

The new androgynous assembly has been designated the APAS-89. Let me remind you of the main point: Two APAS of the same type can dock one with the other. So why was it necessary to modify the old APAS? After all, it was a complete and total success in 1975.

For upcoming projects on orbital stations it is necessary to increase the capacity and enlarge the dimensions of the transfer hatches. It is the base size that determines the dimensions of the structure, and hence of many of its other specifications.

But APAS-89 is not only an assembly for space vehicles. It is a kind of unique technical philosophy or policy: It is envisaged that it will be the base design for a standardized series of assemblies of various design and makeup.

The concept of a standardized series assumes the development of docking assemblies that are compatible one with another and designed for manned missions that both offer the cosmonauts the opportunity to move through a transfer hatch, and significantly simpler and more lightweight assemblies for use in unmanned and combined missions, as, for example, when it is envisaged that servicing, refueling, and repairs will be done in orbit. It is planned to have even extremely simple and lightweight "degenerate" assemblies that do not even have a single mechanism. After they have been placed on an orbiting base platform they will be able to receive for "a holiday" any apparatus equipped with the APAS, or other assemblies from the standardized series.

To put it graphically, the standardized series will make it possible to "cross pollinate" the most varied kinds of orbiting objects. To continue the analogy, we might say that this kind of productive approach will bear fruit and "improve the strain" of future space programs.

In April 1989 I happened to participate in talks in the USSR Glavkosmos [Main Administration for the Development and Use of Space Technology for the National Economy and Scientific Research] with experts from the Comsat General Corporation (United States) about the possibility of conducting joint work to develop a large communications platform that could be put in orbit by the "Energiya" booster.

One of the questions that was asked by the president of this very influential organization engaged in space communications, Mr. R. Mario, had to do with the possibility of refueling and repairs in space. By the end of the century these kinds of communications platforms should gradually replace the present numerous small communications satellites, because space is becoming increasingly crowded in geosynchronous orbit.

The standardized assemblies, which the platforms would be, could become really profitable if maintenance in flight can be guaranteed. In turn, this requires orbital docking of unmanned automatic remotely operated space vehicles, and perhaps also manned vehicles with teams of repair personnel aboard.

Thus, the decisions on the agenda today may significantly influence the development of space technology for an extensive range of missions. The APAS-89 and the

standardized series based on it could become the connecting link for cooperation among separate national programs within an international infrastructure.

Docking is always cooperation!

For the first time an MSB system (reusable solar battery) has started its mission.

Almost every piece of space equipment contains solar batteries. However, for the first time a system has been put into space that can and should be reusable—the MSV.

First of all, in contrast to its others numerous predecessors, it can be repeatedly deployed and folded in space at sizes of 5, 10, and 15 meters. And during its first flight on the Kristall module, immediately after it had been placed in orbit, in accordance with an automatic program the MSB was first deployed at five meters. During the second orbit while being remotely monitored it was given a command by radio (or, more accurately, a set of commands) and the structure deployed to the second intermediate position. The battery sails have now been extended to 10 meters on each side—50 square meters of useful area, that is, six to seven kilowatts of electric power—which immediately reassured everyone—both management and the experts.

But for us working on the MSB, this was nothing but a vacation.

The problem in developing the MSB was unusual because of the combination of its large-scale and complicated mechanisms, and because the structure was designed for space conditions, in weightlessness. In general, we finished up with an installation that could not even stand "independently" on Earth, nor move without outside help.

The help is an entire series of cumbersome stands, for which not all the shops and laboratories in the rocket and space production facilities are suitable in terms of height even though they can handle large dimensions. To test it in a vacuum and at high and low temperatures we found just one suitable thermal altitude chamber located more than 100 kilometers from "home," as far as the city of Zagorsk.

The story of how it was checked and tested for strength under static and dynamic load, and for resistance to vibration in complicated states, and for "rocking," and resonance in its deployed position, and not just that but also for total metal fatigue and fatigue in nonmetallic parts at cycles on the order of 10 to the power of 7, that is, 10 million, could be told separately as a large chapter of this epic.

It is worth making special note that the MSB was developed through ramified and, moreover, interrepublic cooperation. Russians and Ukrainians participated to a greater or lesser extent, and also experts from Armenia and Uzbekistan in the initial stage. The deployable boom was designed and manufactured at the Paton Institute of Electric Welding and Test Plant. The improved and more efficient photoelectric converters (FEPs), which were the cause of all the "fuss," were developed and fitted at the now widely known Kvant Association at the Moscow-3 of the Yaroslavl railroad line. The frames, made from modern composite materials, were made in their final version at the Kompozit Scientific Production Association.

The lion's share was taken by a plant at our Energiya Scientific-Production Association—the Red Banner ZEM Plant, as it is known among citizens—the Experimental Machine Building Plant. I do not say this for effect: The engineers and workers very often did not count the time, and they worked not out of fear but out of conscience. For them, the main reward was their first success—a faultless deployment in space.

But this is only the beginning. The new battery is capable not only of changing shape, it is also mobile. The structure can be completely dismantled and taken to another place on an orbital complex. Viktor Afanasyev and Musa Manarov are now on the space complex doing the preparatory work for placing the panels in a more favorable position relative to the Sun. Each battery with its drive weighs more than 500 kilograms. Even though it is being carried about in space in weightless conditions, it is not easy for a cosmonaut in a suit in open space to handle that kind of mass, and the "road" from the Kristall to the Kvant is almost 40 meters along the entire orbital complex.

It may not be perfect, our MSB. There is still work to do. But it is already a new class of large-dimension structures that are deployable, large, and mobile.

The first stage of the flight of the electromechanical Kristall has been successfully completed. One thing that sticks in the memory during these unforgettable days has been the photographs of the Kristall closing on the Mir at a distance of 200 meters, 20 meters, 1 meter—"Contact," with the deployed panels of the MSB against the backdrop of the onboard computer, and the "approach" and "docking" with the APAS still hidden from sight on the other side...

UDC 521.1

Numerical Estimates of Secular Effects in Translational-Rotational Motion of Orbital Station Having 'Martian' Gravity On Board

917Q0029 Dushanbe DOKLADY AKADEMII NAUK TADZHIKSKOY SSR in Russian Vol 33 No 4, Apr 90 (manuscript received 18 Oct 89) pp 232-235

[Article by D. Z. Koyenov, Tajik State University imeni V. I. Lenin]

[Abstract] A study was made of an orbital station consisting of two identical cylindrical spacecraft that have symmetrical wings (panels of solar cells) and are connected to each other by a long tether. The spacecraft

rotate about an axis passing through their common center of mass. The conditions are defined under which a "Martian" gravity could be created aboard such a station. It is assumed that the angular velocity necessary for creating "Martian" gravity aboard these vehicles is 26.55 revolutions per mean solar day; the mass of each ship is 1600 tons; spacecraft length is 0.5 km; cable mass is disregarded. Calculations were made for a perigee altitude 300 km, apogee 500 km, longitude of ascending node 45° and orbital inclination of station 45°. With such a formulation of the problem formulas are derived for determining the coefficients of the principal secular terms of the pertinent canonical elements. During one solar day such an orbital station with a "Martian" gravity would make more than 15.5 revolutions around the Earth. Figures 1, references 1 (Russian).

'Informator-1' Communications Satellite Launched 29 Jan

LD3001111491 Moscow TASS in English 1102 GMT 30 Jan 91

[Text] Moscow January 30 TASS—The Soviet Union launched a communications satellite, Informator-1, with the Cosmos booster rocket on January 29.

The satellite carries experimental equipment designed to ensure prompt communication and the collection and transmission of information in the interests of the Soviet Ministry of Geology, other branches of the national economy and the further development of amateur radio communication.

The satellite was put into an orbit with the following parameters:
—Initial period of revolution—104.8 minutes
—distance from the earth's surface—1,000 kilometers
—orbit inclination—83 degrees.

The equipment installed in the satellite is operating normally.

The coordinating and computer center is processing incoming information.

Communications Tests To Be Performed With 'Informator-1' Satellite

LD0802104291 Moscow Domestic Service in Russia 0400 GMT 8 Feb 91

[Text] Informator-1 is the name of an artificial earth satellite launched from the Plesetsk cosmodrome, our Archangelsk correspondent reports. Practical tests of communications through space between prospecting parties of geophysicists from a base station will be carried out. If the tests are successful, it will be possible to create fundamentally new complexes of radio-telephone and telegraph communications between remote areas.

Comment on Role of 'Informator-1' Satellite

LD1802231491 Moscow Domestic Service in Russian 2200 GMT 18 Feb 91

[Report by correspondent Valentin Bogomolov from Archangel Oblast]

[Text] The Informator-1 satellite has been launched from the Plesetsk cosmodrome. After the launch, Valeriy Aleksandrovich Grin, one of the cosmodrome administrators, said the aim of the launch is to carry out practical trials in communication between mobile search parties of geophysicists and the base station via space. Such geophysicists' parties are working far into the taiga. In case of success, it will be possible to create fundamentally new complexes for radio-telephone and telegraphic communications between remote rayons, settlements, bases, and also ships that are on voyages.

The local press reports that Aleksandr Semonovich Klinyshkev, the chief designer of the satellite, plans to meet the leaders of the oblast, on whose territory the cosmodrome is situated, to discuss the issue relating to the use of the new technology in providing communications for remote rayons of the White Sea region.

'Cosmos-2123' Navigation Satellite Launched 5 Feb

LD0502130191 Moscow TASS International Service in Russian 1210 GMT 5 Feb 91

[Text] Moscow, 5 Feb (TASS)—Another artificial earth satellite, Cosmos-2123, was launched in the Soviet Union by a Cosmos rocket carrier.

The satellite will carry out work as part of the space navigation system created with the aim of determining the location of the USSR naval and fishing fleet vessels at any point on the world's oceans.

The satellite is placed in an orbit with the following parameters: Initial period of revolution, 104.9 mins; apogee, 1019 kilometers; perigee, 981 kilometers; orbital inclination, 82.9 degrees.

The apparatus on board the satellite is working normally.

The coordinating and computing center is processing the incoming information.

'Molinya-1' Communications Satellite Launched 15 Feb

LD1802093891 Moscow TASS in English 0926 GMT 18 Feb 91

[Text] Moscow February 18 TASS—The Soviet Union launched another Molniya-1 communications satellite on February 15, it was officially announced today.

The satellite will ensure the functioning of a long-distance telephone-and-telegraph radio communications system and relay Central Television programs to Orbita receiver stations.

It was delivered by a Molniya booster rocket to a high elliptical orbit with an apogee of 39,113 kilometers in the northern hemisphere and a perigee of 471 kilometers in the southern hemisphere.

The period of revolution is 11 hours 42 minutes and the orbit inclination, 62.8 degrees.

Communications sessions through Molniya-1 will be conducted as planned.

'Raduga' Satellite Launched 28 Feb

LD0103112591 Moscow TASS International Service in Russian 0926 GMT 1 Mar 91

[Text] Moscow, 1 Mar (TASS)—On 28 February a routine 'Raduga' communications satellite was launched by a Proton rocket. The onboard relay apparatus is

designed to insure telephone and telegraph radio communications and the transmission of television programs.

The 'Raduga' satellite has been placed in a near-geostationary orbit with the following parameters: distance from Earth's surface—34,994 km; period of revolution around the Earth—23 hours, 16 minutes; orbital inclination—1.4 degrees.

The apparatus onboard the satellite is working normally.

A command and measuring complex is controlling the satellite.

The operation of the satellite's communications and television apparatus will be carried out in accordance with the planned program.

'Nadezhda' Navigation Satellite Launched 12 Mar

LD1303091591 Moscow TASS in English 0908 GMT 13 Mar 91

[Text] Moscow March 6 TASS—An artificial Earth satellite, "Nadezhda", was launched by the carrier rocket "Cosmos" in the Soviet Union on Tuesday.

The satellite carries navigational system equipment to locate the whereabouts of vessels of the Soviet marine and fishing fleet, as well as equipment to contribute to the work of the international space system to search for and rescue ships and planes in distress (Cospas-Sarsat).

The equipment aboard the sputnik is functioning normally.

The coordination-computing center is processing the incoming information.

'Molniya-3' Communications Satellite Launched

LD2303092691 Moscow TASS in English 0911 GMT 23 Mar 91

[Text] Moscow March 23 TASS—The Molniya-3 communications satellite was launched in the Soviet Union on Friday by a Molniya booster rocket.

The satellite is used for ensuring far radio telephone and telegram communications, transmitting Soviet Central Television programs to Orbita network receivers and for international cooperation.

The satellite has been placed on the orbit with the following parameters: apogee—39,082 kilometers in the northern hemisphere, perigee—468 kilometers in the southern hemisphere, orbital period—eleven hours and 41 minutes, orbital inclination—62.8 degrees.

Communication sessions via the satellite will be conducted in accordance with the schedule.

Satellite TV Reception System Produced

LD0703221191 Moscow TASS International Service in Russian 1215 GMT 7 Mar 91

[By TASS correspondent Aleksandr Lipskiy]

[Text] Minsk, 7 Mar (TASS)—The "Gorizont" production association in Minsk has prepared for release onto the country's consumer market a satellite television system, intended for receiving scores of programs of foreign TV companies. The new product, which is technically not inferior to similar foreign products, is an original development by Minsk electronic engineers.

"This year we intend to produce only 50 such devices," Aleksandr Urbanovich, the association's chief engineer, said in an interview for TASS. For starting mass production, we do not have sufficient hard currency to purchase high-precision components abroad. Unfortunately, the republic is situated in a so-called "unreliable reception zone," which is why our equipment will not produce a high-quality picture without imported converters.

As recently as a few years ago the import into the Soviet Union of such devices was forbidden. The normalization of relations between East and West in the framework of perestroyka has opened the doors of our country to satellite aerials. Belorussia has become a pioneer in establishing the production of Soviet satellite TV systems.

'Almaz' Radar Satellite Launched 31 Mar

LD0104193191 Moscow TASS International Service in Russian 1420 GMT 1 Apr 91

[Text] Moscow, 1 Apr (TASS)—The 'Almaz-1' automatic space station was launched in the Soviet Union from the Baykonur Cosmodrome on Sunday [31 Mar] by a 'Proton' carrier rocket.

The purpose of the launching is a continuation of research into the surface of the earth and the world's oceans by a radar method of remote sensing, begun in 1987 on the 'Cosmos-1870' satellite.

The 'Almaz-1' flight program provides for filming of the territory of the Soviet Union and other countries in the interests of geology, cartography, oceanology, ecology, agriculture, as well as the study of the ice situation in high latitudes.

The station has been placed in an orbit with the following parameters:
maximum distance from the earth's surface [apogee]—280 km
minimum distance from the earth's surface [perigee]—170 km
initial period of revolution—88.7 minutes
orbital inclination—72.7 degrees

The apparatus aboard the station is working normally.

Improvement of Facilities, Services at Baykonur Urged

907Q0140 Moscow PRAVDA in Russian 4 Aug 90 Second Edition p 2

[Article by A. Tarasov, PRAVDA special correspondent: "Moments of Linkup"; first paragraph is source introduction]

[Text]**Yesterday, after the Soyuz TM-10 spacecraft docked with the Mir orbital complex, the joint work of two crews began. The work involves a number of technical and biomedical experiments. Prior to their landing, which is scheduled for 9 August, Anatoliy Solovyev and Aleksandr Balandin will hand the growing orbital complex over to Gennadiy Manakov and Gennadiy Strekalov.**

The craft arrived at the meeting place very properly clad—the "tile-leaves" of the soft shielding, which caused so much trouble on the Soyuz TM-9, had held in place. Yu. Semenov, general designer of the Energiya Scientific Production Association, said that that had not required any additional measures—it just took meticulous implementation of standard design solutions.

Such linkups would occur more often, say the space technicians calmingly, if work went on in a peaceful and measured way, without any sensationalism. There would be more linkups in general, and without them there cannot be advances either in space or on the Earth. I would like to support them and share some observations on about the linkup that I brought back from the Baykonur cosmodrome.

This summer, the cosmodrome marked its 35th birthday. A mature age, coinciding at last with the opening of the gates of the test range, which had been securely boarded up to the outside world. That is, an age that coincides with a linkup that, by and large, should determine its further fate.

Among the signs of that great linkup was our meeting with Colonel-General V. Ivanov, the director of the space units of the Ministry of Defense, at the new Baykonur press center. Vladimir Leontyevich told us about himself—the typical track of an officer in a missile unit, a one-time Navy lieutenant from a torpedo boat, who went on to become a crew chief at the Plesetsk Cosmodrome. And he told us about the space units, which include the engineering-test subunits of cosmodromes and command-measurement complexes from the Crimea to the Far East.

It's nice that, in connection with that admission, there's no longer any need to convulsively redress cosmodrome personnel in civilian clothes whenever foreign guests are near. For the hosts, donning that disguise was always a lot of trouble and it was humiliating; for the guests, it was obvious and merely evoked irony. We journalists were "ashamed of the state." How many difficulties and deprivations had the rocket specialists lived through here as they gave wing to our country's space program, what amazing engineering skills they had displayed on a daily basis, how intelligent and inspired were the faces of the young lieutenants and captains, and how severe and manly the permanent sunburn of the engineering colonels who had spent their lives at the launch pads in the bitter heat and cold of these steppes. And not a word about any of it. Was that fair?

But the time for hymns has passed. Certainly, everything here is a cause for joy, touchingly so. Every bush left intact, each fresh building facade, and especially the local Arbat for pedestrians, lovingly laid with flagstones at the center of Leninsk. Yes, it's very touching and a cause for rejoicing. But by what yardstick?

Now that we have embarked upon a linkup with the world and have allowed streams of foreign journalists, specialists and businessmen in for trade and cooperation, let's try to take a look at ourselves through their eyes.

We ride in a stuffy bus that stumbles along a well-worn road from the airport to the city. "Why are there so many public restrooms?" a foreigner next to me whispers in perplexity. Yes, outside the window we see dozens of "birdhouses" crowded together. But this is a local dacha area—plots with a pretty good, I hasten to say, harvest, but built up in a very wretched way.

All right, the good fortune isn't in the rural cottages. But all the same, how does the average Japanese, American, Dutchman, Austrian, Australian, etc., justifiably see the place where spacecraft have been launched for thirty years? The first space harbor of the planet? That about which we have written all these three decades with "oohs" and "ahs" as being the scientific and technical hub of the Earth?

Oh, for sure, by the standards of the civilized world (which includes Saudi Arabia and possibly some countries we have never heard of) there should be skyscrapers—offices and hotels. There should be cool cottages for workers fatigued by the heat. And each cottage has its swimming pool—yes, dozens of swimming pools with clear water.

That's fine. And all that already exists in the world. But it's not true for us, unfortunately. Instead, here the once nice and comfortable typical military settlement is already falling apart because of the shortage of funds and pipes. The "Motyga," a trolley packed to the gills, departs each day at four in the morning from the square and returns at night. It is absolutely pitiful to see on the dusty or muddy banks of the Syr-Darya slender young officers and their young wives, who look like they were brought here from beauty contests, trying to get a suntan. And good for them—in their imported bathing suits, they still have the bearing of daughters of millionaires on Hawaiian beaches, and they haven't lost their pride.

And this has been going on for so many years—has it really been impossible to hire a serious cooperative, to negotiate profits if there are no resources available? Here

the revenues would have started to roll in long ago and the river banks would have been transformed into a resort area, into the gardens of Semiramis.

Baked through and through by the burning heat of the test range, Lt. Gen. Aleksey Leontyevich Kryzhko, the director of the cosmodrome, smiles sadly at my naivete:

"Well, we military people do not have the right to conclude such agreements. And the city executive committee will not take over city management, although we would be pleased to hand it over...."

I pay a visit to the chairman of the city executive committee. Viktor Andreyevich Ugryumov sits solemnly in a shabby, banal little building of Leninsk, which clearly demonstrates the weight carried by the military and civil authorities.

"We would be happy to take over the city management. We declared city ownership of the land of the city of Leninsk in order to bring that territory into order. But we can't manage the city unless we have the proper financing—that's 20 million rubles, and engineering facilities appropriate for an operation of that size. Otherwise, such a transfer would be senseless; our lack of power would only ruin the city."

Is that fair? Yes, it's fair.

Like in the old days, we could cast a stone at the military: they drove the economy into a corner, and then they try to blame someone else. But, after all, the cosmodrome managers are hamstrung by their rules. No matter how you race between the launch pad and city management, you can't do everything. The departmental calculus of the social and cultural life "per capita officer" has got everyone perplexed—both the military and the citizens.

That means we need another linkup—this time, of military and municipal authorities. And it's not just a matter of some given amount of money and bulldozers. It's also a matter of a fundamentally new approach to the industry of providing service to the people. Yes, we've set up an industry for servicing rockets and spacecraft, you can't deny that. But we've forgotten about people in the process. But if we don't take care of the people, in the long run we ruin technology as well.

However strange it seems, this land awaits its master. One who also will have an interest in such an enormously profitable business as today's space program. He has no less of a right to those profits than do Glavkosmos and space firms. But here we need to have a real linkup between the space sector, military departments and local civil authorities.

We are not yet used to solving such problems. Launching spacecraft, we are used to, but the other, no. When you see pavilions or kiosks trimmed with a soldier's paint brush, or the window handiwork of small cooperatives, you understand that we are making an honest effort, but we don't have the know-how.

We are taking the first steps. A school of young cosmonauts is being established. The first harbingers of that were 26 school children from Kazakhstan who for 12 days studied rocket and space technology right at the launch pads and in the assembly buildings. Their questions made even the most experienced test engineers sweat, according to the head of the political section at the cosmodrome, Maj. Gen. A. Naudzhyunas (not long ago, he was elected secretary of the Central Committee of the Communist Party of Lithuania).

In the future, he states, plans call for the organization of an international space school under the sponsorship of the Baykonur Cosmodrome, the Energiya Scientific and Production Association and the Kazakhstan Center for Public Television "TV-Aziya."

In addition, Kazakhstan has received an offer from a Saudi Arabian sheik to build the complex for the international school. On dozens of hectares of Baykonur lands—a study building, boarding facilities and a hotel. That is still somewhat unusual for us, but it's extremely attractive. That represents yet another linkup, and I would like to wish it success.

It made me very sad that, in his speeches before journalists, Yuriy Pavlovich Semenov saw as the main threat to all our possible advantageous linkups with the outside world the "carping" of the press. The word leapt from him several times. Yuriy Pavlovich, dear friend! Our press has not taken to criticizing, much less carping. It has merely restrained its ardor and taken a more sober look at the space program. It takes the space program to heart as much as you do, and the same goes for the space program's payback, profitability and effectiveness.

But let's take a look through the eyes of those who are linking up with us at the pock-marked facades of residences, at the window-replacing plywood and foil out of which protrude overstrained apartment air-conditioners, at the cracked roads and the garbage dumps, at the cockroaches and the chlorine toilet-smell in the stifling hotel rooms...

Those who are linking up with us think, If you can't take care of yourself, how are you going to handle a marvel like outer space? And prove it...

We know that we can. We know that our people are priceless, that they have know-how, endurance and selflessness. But isn't it time that we returned to them what we owe them for these 35 years of intensive economizing? Be on mutually advantageous terms—not only with foreign partners, but also with our own flesh and blood? That is the motto I would propose.

And then, things happen for a reason—the fires in test range pressure chambers, the tiles tearing away from spacecraft, the broken hatches. The depreciation of human beings is also not without a price.

I know that the Energiya Scientific Production Association is from one department, the space units from

another, the city executive committee from a third, etc. I know that they all have different bookkeeping. But without a real linkup down here below, there won't be linkups up above. And I know, moreover, that if Sergey Pavlovich Korolev were still alive, he would find a way to fight for those linkups.

Let's assume that the space program in our country, as before, is tops. And let's assume that attention is being devoted to a "ground program." But after all, it can't be done without an equal linkup. Linkup in space is the crown of many linkups on the ground. And every linkup is like a moment of truth, showing how everything really is, showing its true colors.

Lt Gen A. L. Kryzhko, Chief of Baykonur Cosmodrome

917Q0009 Moscow KRASNAYA ZVEZDA in Russian 18 Sep 90 First Edition p 2

[Article by Col M. Rebrov: "Chief of the Cosmodrome"; first two paragraphs are boxed material in source, with the head "The Time Has Come to Tell"]

[Text] **I immediately foresee the question: chief of which one? In fact, the country has three sites from which space rockets are launched in putting into orbit satellites, interplanetary stations, and manned craft. They are Kapustin Yar, Baykonur and Plesetsk. Our article will be about the chief of the Baykonur cosmodrome.**

For a start, here's a little information about the post itself. It was established in 1955 after the 2 February decree of the USSR Council of Ministers No 292-181 designated the place and date of the beginning of construction on Test Area No 5. That is was it was called at the time. The authorized personnel levels for the subdivision that was being created included 586 soldiers and 325 blue- and white-collar employees. According to data in the "Historical Record," the first person to occupy the post of chief was Lt Gen Arty Aleksey Ivanovich Nesterenko (1955-1958), a front-line soldier who had spent the war with the famous "Stalin organ" multiple rocket launchers and who was the recipient of the USSR State Prize (then the Stalin Prize). He was followed by Gen Konstantin Vasilyevich Gerchik (1958-1961); then the chiefs of the cosmodrome (as Test Area No 5 later came to be called) were Gen Aleksandr Grigoryevich Zakarov (1961-1965), Gen Aleksandr Aleksandrovich Kurushin (1965-1973), Gen Valentin Illarionovich Fadeyev (1975-1983), Gen Yuriy Nikolayevich Sergunin (1978-1983) and Gen Yuriy Averkovich Zhukov (1983-1989). The present-day chief of the Baykonur cosmodrome is Lt Gen Aleksey Leontyevich Kryzhko—the eighth in the line. He is the chief about whom I want to tell you.

He was born in the Crimea into the family of a worker. His father was a blacksmith, and his mother worked in a sovkhoz. In Pobednoye village he graduated from the seven-year school, then from the highway technikum and served as a private in the 34th tank training battalion. He did not return to civilian life. He received his military education at the Saratov Technical School and the Mozhayskiy Academy. He served... More simply stated, where didn't he serve during his service years? His career as an officer threw him into the Baltic region and the Volga region, took him to the Urals and the Far East. He walked with and rode on self-propelled rocket launchers through Siberia and the taiga. As he himself says, he moved vertically and horizontally on the service ladder. His last post prior to his assignment to Baykonur was as first deputy commander of a large strategic formation in the Strategic Missile Forces.

He looked upon the order for a transfer to Baykonur with some reservations: it would be interesting, captivating work, but also devilishly complex, incomparable in its "parameters" to what he had done before. The management task would be so enormous, the equipment would be of "all shapes and sizes," and the people would be so extraordinary both in terms of number and skill levels.

He knew his predecessors only by their last names. In fact, he had chanced to meet some of them at conferences and meetings, but not many. There was no one to seek advice from, and the conversation with his superiors had the character of a one-sided briefing: he had to take the new post. And that "had" did not allow for doubts or refusals.

And nevertheless there were doubts. Internalized and private.

"In general I had an idea of what was required of me. But how to do the job? I'm searching for a way! I'm hoping to find it. For the time being, I 'm at the very beginning of my search. There's still much for me to grasp, and there will probably be errors. But I'll keep searching for the best way!" So he stated in our first frank discussion, and he added:

"Here are gathered different people, people who do not fit into any kind of mold, and few of whom your experience or training has dealt with, but to whom you must prove that that you have the right to lead. And that, in actuality, is very difficult...."

Chief of the cosmodrome—a downright unique post. The range of problems is enormous. It involves military service, and the testing of new equipment, and economic problems, and multilevel tests of new space vehicles, and the solution of scientific research problems in which one must deal with things that are still "only in the mind"....

And nevertheless, the most important thing is people, an enormous number of people. To direct them, you have to know them and understand the problems they solve. "One mustn't disrupt a mechanism that has taken decades to fine-tune," said the general. And after his words, problems have come up that torment him every day.

At the cosmodrome, the interests of the many departments intertwine, sometimes meshing, other times colliding. Situations of conflict occur, sometimes acute.

Resolving them through compromise, by "averaging the truth," is not always possible. And there are not two truths. The interests of the business at hand require evaluations both of one's own principles and of the principles of others. Only here, each person understands principles in his own way and defends, above all, his own interests.

"The engineering and scientific elite come here. Chief designers and general designers, who are interested in fast, high-quality execution of the tests. Here at Baykonur we understand their concerns—they are our concerns. But the possibilities are not always consistent with one's desires, and only mutual understanding facilitates the work...."

I ask Aleksey Leontyevich: "Where is the chief of the cosmodrome when launch operations are under way?"

"Where? Oh, there's no doubt about that. He's wherever the main problem in the engineering process is being dealt with. But don't think that I intervene in the work of the test personnel or the launch crew. The obtrusive presence of commanders paralyzes the initiative of people and makes them nervous. I arrive at the launch pad, and a fleeting glance is all I need to evaluate the situation, to ascertain whether my presence is needed. Our people are very responsible, experienced. And there exists the concept of the 'limit of resources.' If I feel that it, the limit, is just about to be crossed, then I intervene. And then there are deputies and service chiefs. Where and what will be done today is known the night before. It is best to solve all problems prior to the start if operations and not when the operations are under way. Especially since with rocket hardware, there are irreversible processes.

"Yes, the test specialists of Baykonur are special people, and I've been convinced of that more than once. They also have to deal with equipment that has never flown before. How will it behave during the first launch? How will it function in flight? Those who conduct the tests aren't entitled to make any errors, to be negligent. After all, in some cases, there's not even a duplicate for a piece of hardware. Ruin it, and you set the work back several years. The losses are enormous—in material, in time, in morale."

At Baykonur I heard the following: "The test specialist must not lag behind the thoughts of the chief designer, otherwise he will get tangled up in the legs of those who are moving forward." It is even felt that the test specialist should, in some way, move ahead, that he should propose to the designers possible variations of designs of the given systems of a complex. He, after all, has the experience.

"During testing," explained Aleksey Leontyevich, "communication assumes a unique form. The customary subordination, the strictly by-the-book regulations may, in such a stressful situation, and because of the shortage of time, become a hindrance. People understand one another in a glance, in a gesture. There is no time for superfluous words."

The workday for the chief of the cosmodrome by routine begins at 0830. He can be found at the headquarters at 0800, or even at 0730, and here and there on a job site even earlier. Everything depends on the circumstances. After 1800 he is still in the workplace.

"And after 2000, maybe 2200?" I ask.

Aleksey Leontyevich casts a glance at the clock and smiles wearily. The cosmodrome has long been enveloped in nighttime darkness, but our conversation continues, and one one of the officers still sits in the reception room and trusts that he can settle his business and concerns today.

And the plans for tomorrow call for the next launch, and therefore it will be necessary [for Kryzhko] to get up at 0530. Among all the things he has to do is a meeting with the general designer, a session with the State Commission, the concerns of deputies, and an intricate conversation with the Communists who elected him to the Party Congress. That conversation could have been held earlier, but General Kryzhko felt that the people needed to reflect a little about what has taken place and he needed to weigh and evaluate a great deal.

"Some 70-80 percent of the time goes for daily needs, social needs. It's unfortunate, but you can't escape it."

"But in the city there is a Soviet organization, deputies and an urban committee of the Party. Shouldn't they take some responsibilities upon themselves?" I say, trying to ascertain the situation that had recently come about. However, not that recently.

The general does not respond immediately. He looks in the direction of the residential quarters that are under construction and then at me, as if doubting, or trying to determine, whether I will understand him, whether a person from the capital, unfamiliar with everyday life at Baykonur, can at all feel, or sense or guess that at times here nothing is at all what it seems. And that's how it should be!

"A city executive committee does, in fact, exist, but it avoids many concerns; the city management does not want to deal with those responsibilities, although we would be happy to hand them over. It's simpler for them that way, and they can just dump all the messy things on the military."

The city of Leninsk is the administrative center of the cosmodrome. Tens of thousands of people live there. Many travel from there to the "pads," which are their workplaces. The road system must accommodate that and other traffic. Ten to twelve trains of 14-17 cars each (to be more precise—gasoline-powered locomotives that are called "motygi" [scrapers] here) head out everyday along their widely spaced routes—in the morning and in the evening. At night, they deliver freight. Some 300 cars

arrive daily. The people must be fed and supplied with goods; there also is a category of "technical freight," which comes from the plants, enterprises, design bureaus and science centers.

Here are several figures to illustrate things. Each day, the cosmodrome services require 180,000 cubic meters of water. The Syrdarya provides 100,000 cubic meters ("That long-suffering river is polluted by three republics, and we drink its water.") Here's another figure—70 tons of bread. The city's bakery solves that problem only partially. And then there is the consumption of electrical power. Baykonur gets it from the northern and southern parts of the country. The incoming power does not always "match up in terms of time and technical quality." However, interruptions in the supply of electricity give rise to serious complications at sites where tests of rocket-space technology or prelaunching work are under way. I repeat: a number of processes have an irreversible character.

"My most difficult day? At first, every day was difficult. Here nature itself is capable of bringing surprises: in summer, the temperature is over 40 degrees; in winter, it's almost the same figure, but with a minus in front of it, with hard freezes and wind. It is difficult to cover the entire highly varied cosmodrome facilities. The launch of the Kristall module was not at all easy, and not everything has gone well with other launches. In such cases, I said to myself, 'Calm yourself, get it together. After all, you've been through things like this before.'"

"And what 'things' were those," I ask the general.

"From my former, military work. Once, training exercises were under way that simulated actual launches. Everything was calculated to happen on a schedule, with no simplifications of the the conditions. The missile units began their movement, it was a long trek, and there were no roads," he said, falling silent a moment. "We were about to cross a river, and suddenly it rose. A rocket launcher weighs 100 tons, and it's bulky and cumbersome. And you couldn't get any closer to the river itself than 1-1/2 to 2 kilometers. Where was the bottom? What was it? And time passed, inexorably slow. The men took their clothes off and stood like landmarks in the water, indicating a ford and the approaches to the pontoons. Two-hundred and something kilometers had to be covered, and we had to go, in particular, through regions where the taiga was sweltering. We got through."

"And nothing went awry?"

"Of course things went awry. But the main mission was accomplished. In such cases, I think to myself, Where is it and how can you determine it—the limit of human capabilities?"

Fate arranged his profession in its own way. With an energetic approach toward life, his moral code is such that he feels a sense of responsibility in anything that's assigned to him.

"I also recall another case," says the general. "I happened to be in charge of the destruction of SS-20 missiles that was called for by the well-known agreement with the Americans. They were present during the activity. We destroyed them by launching them. As they say, the 'enemy' was alongside us and we actually showed him our skill. I didn't want to blunder. All 72 launchings went off with exceptional precision and accuracy."

Later, we had other meetings and conversations. About matters involving deputies and about strictly service matters, about how difficult it is to be everywhere, about forthcoming tests of a new rocket system developed by Academician V. F. Utkin, and about "sensationalist" books and motion picture films—those that are admiring, those that are express disappointment. His phrase sticks in my mind: "I feel that in life the fellow who has decided in advance that it is impossible to embrace the unembraceable is a fellow who in general will do nothing."

When I asked Aleksey Leontyevich what helps him in a difficult moment, he smiled and answered: "My home, my family. The children have already grown up, and we have grandchildren. My wife is a teacher. We argue about education, about those who will take our places. Teaching is the science of sciences. That's also true for the chief of a cosmodrome."

Problems With Secrecy. Relations With Local Populace at Baykonur

917Q0039A Moscow PRAVDA in Russian 28 Dec 90 p 3

[Article by A. Pokrovskiy, special correspondent of PRAVDA, Baykonur-Moscow: "Spaceport Arrhythmia, or Sad Reflections on Happy Achievements"]

[Text] With a light heart I want to confess to my complicity in a closely guarded secret. We brought two waitresses from our hotel on the journalists' bus through three control and check points to an observation post. This confession is made the easier because the observation post on that day looked more like an international fair than a secret facility. Advertisements of foreign companies were stuck up wherever possible. Guests were gabbing with each other in Russian, Kazakh, Japanese, English, and god only knows what other languages. Some pedlar had set up tables with souvenirs for sale. And a few minutes before the launch of the "Soyuz TM-11," a flock of American tourists fluttered from the comfort of the bus, and immediately started filming everything around with their camcorders. Only two elderly ladies were denied admittance, citizens like thousands of others in Leninsk, the city that has grown up next to the spaceport, and for the sake of the spaceport.

As a personification of this power of denial, six stalwart youths were standing near one of the pavilions of the observation post, wearing everything but body armor. Who had posted them there, and to what purpose? If they were guards, then what were they guarding and from

whom? If only especially honored guests were being passed, then wouldn't one have sufficed against the force of two courteous folks, and not with such an arrogant bearing? But no matter whom I asked, civilian staff members or military, all shrugged their shoulders: "That's the way it is, standard operating procedure. When there's a launch, even the guys from Moscow come in to lend a hand to the locals. And there they stand."

It stands to reason: standard operating procedure would be the rule at the space center of any nation. And there could scarcely be such a naive simpleton who would call in the corresponding services just to stand around looking stupid. But at the same time, the people should not be cut off from such national shrines as the homes of S.P. Korolev and Yu.A. Gagarin, or the local space museum, which incidentally could tell us a lot about the role of spaceflight in our lives. And is it reasonable to declare an entire city nonexistent? Leninsk is known to the entire world, tens of thousands of foreigners have been there, its space photos are published in foreign newspapers, but just try to find the town on our maps, even in the flight schedule for Aeroflot!

"Three boats come in anonymously every week," said an officer friend. "But I can't invite my mother for a visit because the hassle in getting travel documents made out is beyond the capacity of an elderly lady."

One more such inconvenience for people living a hard life (more about that later) and doing a taxing job would, in my opinion, start them thinking: is such secrecy advisable? But things are much more alarming.

Total secrecy involuntarily elicits suspicions: what are they doing over there, right next to us on our land? And isn't it something that will be bad for us? So we can understand the bitterness in the words of N. Nazarbayev, President of the Kazakh SSR, in an interview: "People ask me why Baykonur is closed to visits by citizens of the republic, but open to foreigners. I have no answer for them."

An answer must be found, for the situation is becoming increasingly stressful. The Committee for Environmental Protection of Dzhezkazgan Oblast has already brought suit against Glavkosmos [the main space administration] of the USSR for littering property with spent rocket stages and fragments thereof. Meetings against alienation from former pastures are now beginning to rumble. Dreadful to relate, a repercussion of inflamed passions has been the slaughter of military patrols on the streets of Leninsk and, so I have been told, shots taken at officers on the open steppe. Neighboring farms unwillingly sign agreements with the spaceport to supply produce: "This is how you will be fed."

And now perhaps it is time to return to the promised story about the "good things" of life for spaceport workers. We go back to the time when the spaceport and the city originated, when no one even assumed that spaceflight would become an item of commerce, and Leninsk would be a center for tourism. Rockets were the main concern, and little thought was given to the people who would be launching them.

The erection of a dock of the universe in the unbounded semi-desert was truly a heroic deed to its builders, the highest achievement of Soviet science and engineering. The trouble is that even today, life and work here can be likened to a heroic deed, but now in a struggle with everyday difficulties. And nothing is heard about the particular achievements in this struggle. Judge for yourself. Bakeries, dairies and other enterprises were planned for a population of 10,000. Now that the city has eight or nine times that figure, the aforementioned enterprises are holding out only by dint of will. Ration coupons for staple goods have long been the companions of the citizens of Leninsk. What is one to say when there simply is no good drinking water, and people, including children, suffer from hepatitis, intestinal and other illnesses? Construction of an aqueduct has been stopped just 20 kilometers away from the city.

Housing is in short supply, and what there is leaves you sweltering in the 100-degree heat or shivering in the subzero cold with the breeze blowing from the steppes. I have been at the spaceport regularly for the past twenty years, and I never cease to be astounded by the marvelous technology here, and even more by the fortitude of the people who have mastered outer space. But it seems that their patience is coming to an end. An unprecedented event, a strike was half held and half intended to be held against working and living conditions at one of the pads. We never managed to get the details. The military know how to keep their mouths shut.

It is bitter to relate all this, but what will we do if the spaceport falls ill? The heart of our space program is beating in pronounced arrhythmia of achievements, as the saying goes, "above world level" in derangements of internal and, so to speak, external order. It still has not come to a vascular embolism, but it's close.

Every time I am here, I cannot but recall the speakers of various levels who tell us with ardent incompetence that the space program is lolling in luxury on the money of the people. They should take a first-hand look at the intricate business of the space center, talk to the people and then listen once more to what they say about the achievements and problems of the spaceport. Would they accept the responsibility for the antispaceport mood caused in part by their words?

Of course, this is not just a matter of words. We are somehow at odds with the modern high-tech world. We have pushed the chemical industry off into a corner, and left ourselves without many medicines, and even without soap. We have thrown tantrums around electric power plants, and now we shiver not so much from the cold as from anticipation of it: will there be enough heat for everyone? So can we really forget what the space program has given us?

Where does all this come from? From incompetence, surely. But what is the source of the incompetence? Take a look at all the "fences" thrown up around your creations, you makers of high-tech wonders, and you will understand what gives birth to myths of industrial monsters. Those myths can be shattered by reasonably provided information and, it goes without saying, dependable work. This has apparently been understood at the Ministry of Nuclear Power Engineering and Industry, and an extensive dialog with the populace has begun. It is a strained dialog, of course, a lot of time has passed. And this is also worth consideration by the representatives of the space sector of industry.

It seems to me that those in charge of the spaceport have to share some of the responsibility for not yet having found a common language with the local citizenry. The habit of keeping closed off from the surrounding world right next to the unit has its effect here as well. But whatever else may be said about the army, it has now become a focus of the scientific and engineering intelligentsia, for one would be hard put today to find an officer without special technical education, particularly among the missile troops. Hence, each unit may also become its own center of scientific and engineering progress, especially out here in the boondocks.

The populace must be given a sense of the advantages of such a neighborhood, the profit of using the infrastructure built up around the unit, of rental payment for alienated lands, and so on. After all, economic conversion is knocking at our door, and let its warm breath touch first the nearest neighbors of the space center. In a word, there is something for both sides to consider here, as well as our legislators. The fruits of scientific and engineering progress, whether they be chemical production, nuclear electric power plants, or spaceports, have been called into being not to frighten people, but rather to enhance their material and spiritual well-being. Perhaps this is the whole secret of the spaceport's arrhythmia.

Glavkosmos Being Sued Over Space Debris Contamination

PM0402113591 Moscow PRAVDA in Russian 30 Jan 91 First Edition p 8

[Report by PRAVDA correspondent V. Ryzhkov under "Tickertape" rubric: "Payment for 'Rain'"]

[Text] Metal falls from the skies in these parts, and the pastures of many farms in Dzhezkazgan Oblast are littered with space "refuse." In attempts to maintain secrecy the spent stages of booster rockets were for many years blown up here and the fragments scattered over the fields, contaminating the land with toxic substances. But who at that time could make military departments pay damages?

A year ago there were finally signs of progress. Representatives of Glavkosmos [Main Administration for the Creation and Utilization of Space Technology] went to Dzhezkazgan. They gave their word that they would restrict the areas where the "metal" falls from the sky, alter the method of blowing up the stages, and clear pastures of the fragments. A special subunit was even organized for these purposes.

The set date has passed. But the major department has not entirely kept its word. Only 8,000 tonnes of space "refuse" have been collected in the intervening period. At this rate the "harvest" will drag on for many years. So Glavkosmos is being sued for 1.7 million rubles. Only will it be able to pay?

Plesetsk Cosmodrome Officials Stress Benefits to Local Areas From Space Operations

LD1703115391 Moscow All-Union Radio Mayak Network in Russian 0640 GMT 17 Mar 91

[Text] [Announcer] Cosmodrome and the Far North is the subject of a report by our correspondent, Valentin Bogomolov.

[Bogomolov] On clear, cloudless nights the citizens of Arkhangel sometimes see rockets rising into the sky above the city. Occasionally they are mistaken for UFO's but, at all events, everybody here knows that the world's busiest space launch site, Plesetsk, lies right next door to Arkhangel. But what benefit do Arkhangel Oblast and the Far North, which lie under the rockets' flight path, derive from the Cosmodrome? This is the question we put to Col. Grin, one of its commanders

[Grin] Recently we launched the Informator spacecraft. This is the first experiment in a series intended to test ways of maintaining communications with remote regions of the country, with settlements, with geological prospecting teams, with those regions and installations within the country where the use of traditional means of communication is inappropriate and economically unviable.

Recently, at the end of December, we signed an agreement on the launch of the Resurs spacecraft, which is designed to survey the earth's mineral resources and carry out ecological monitoring. In other words, it will carry out a comprehensive survey of Archangel Oblast in the interests of the national economy. It will study the location of mineral resources, the use of timber resources, and the ecological situation in Archangel Oblast.

[Bogomolov] I know that geologists are obliged to acquire satellite charts from the Americans. Can they not see your space photographs?

[Grin] Of course they can. Furthermore, as a deputy in the oblast soviet, I took part in this work. Maps compiled from satellite measurements, including ones of other oblasts of the Soviet Union, were displayed at a session

of the oblast soviet. Some of these measurements were taken during orbits over oblasts which neighbor Arkhangel Oblast.

[Bogomolov] Here is what Gen. Oleynik, the commander of the Cosmodrome, had to say about the benefit which Archangel Oblast derives from the Cosmodrome.

[Oleynik] The program can be adjusted to find out how man's activity is affecting the environment in Archangel Oblast, where the ecological situation has deteriorated lately. But I do not know the activities of the Cosmodrome for this. Rather it is the fault of industrial enterprises located in Archangel Oblast. Our spacecraft will be able to assess the extent of air and water pollution, the state of forestry plantations, and the state of the soil. We will also be able to measure the impact of human activities in our region on the ozone layer.

[Bogomolov] But is this not very expensive? Every launch costs many millions of rubles.

[Oleynik] The life of man and the future of the region are more important than the money we plan to spend on this reserch. [end recording]

[Announcer] I wholly agree with that last remark. I remind you that the life of man is more precious than the money spent on scientific research, especially as the next generation, in other words our children, is at stake. One hopes that our small loved ones will be able to eat clean food, swim in clean rivers, and breathe clean air. If they do, maybe they will be morally better than us. One very much hopes so.

Allegations Concerning Cosmonaut Losses, Gagarin's Role Refuted

907Q0167 Moscow KOMSOMOLSKAYA PRAVDA in Russian 22 Sep 90 p 3

[Article by KOMSOMOLSKAYA PRAVDA staff correspondent Ye. Chernykh, Prague: "Was Gagarin Really in Space?: Cosmonaut No. 1 Flew Around the Planet One Time. But This Fairly Shabby 'Canard' Is Making Its Umpteenth Orbit"]

[Text] The book "Gagarin—kosmicheskiy lozh?" [Gagarin—a Space Lie?] came out recently in Hungary. The author, I. Nemere, alleges that Gagarin did not fly around our planet on 12 April 1961. The Vostok craft had gone into space several days earlier. In it was the son of the famous aircraft designer, Ilyushin. But after a difficult landing, he looked more like a human wreck than a Soviet "hero." Someone like that couldn't be shown to the world. Just the opposite, he would have to be kept out of sight for a long time, or better yet, for ever. In that same year, Ilyushin was in a serious traffic accident.

An attractive fellow with an optimistic smile and excellent biographical particulars was quickly found from among the workers. He also played the role of the representative of the grandiose success of Soviet science and especially of Soviet policy. It is clear that a person with such a terrible secret could not live long.

I. Nemere, a social and political affairs writer, spent many years in Moscow, where he met "with knowledgeable people." He concealed his authorship right up to the publication of the book, fearing that, even in Hungary, there would be people who would be prepared to take whatever steps were necessary to preserve the legend and the eternal "truths." It wasn't until a press conference at the end of August that journalists learned the name of the author of the sensational book.

They have lived for some time in the fraternal countries of socialism, and I can visualize the reaction. They are removing the statues of Lenin and defiling the memorials to the Soviet soldiers. Now they have even gone after Gagarin.

But it is someone "from among them" who came forward in defense of Gagarin—the famous Czechoslovakian journalist and author of 12 books on the space program, Karel Patsner. His article has just been published in Prague by the newspaper MLADA FRONTA DNES. One detail: after 1968, Karel had big problems. So, wish as you might, you cannot regard him as a staunch Marxist ready to defend "communist legends" at any price.

"To tell the truth, doubts about Yuriy Gagarin being the first person in space are nothing new," wrote K. Patsner. "This began back in the mid-1960s. All the rumors that appeared in the Western press were filed by the American writer, D. Oberg, in his book 'Secret Soviet Accidents,' published in 1988. Cosmonaut Lodovskiy died in 1957 while taking off from the Kapustin Yar cosmodrome. In that same year, Shiborin died. Two years later, there was the death of Mitkov. A cosmonaut, still unknown to this day, crashed in May of 1960. In September of 1960, while Khrushchev was giving a speech at the UN, an unknown cosmonaut died, identified at one point as Petr Dolgov. On 4 February 1961, some Western amateur radio operators picked up a transmission from an astonishing Soviet satellite of the 'beating of a human heart,' which faded away shortly thereafter. According to some reports, two Soviet cosmonauts were circling the Earth and, according to others, there were three of them: Belokonev, Kachur and Grachev. In early April 1961, Vladimir Ilyushin flew around the earth three times, but he was injured during the return. In mid-May 1961, some amateur radio operators in Europe caught a weak call for help coming, apparently, from two Soviet cosmonauts. On 14 October 1961, a Soviet craft with a crew was lost in the vast reaches of space. In November of 1962, Italian amateur radio operators heard SOS signals from space. According to some sources, that's when Belokonev died. On 19 November 1963, an attempt to place a second female cosmonaut into orbit ended tragically. One or more Soviet experimenters, again according to the reports of Italian amateur radio operators, died in April of 1964.

"Oberg himself was previously engaged in military missile research and worked at NASA's space center. He emphasized that all those reports were absolutely false.

"However, even Oberg, although a specialist himself, could be wrong. But there are also other sources. Of course, one can't believe the official Soviet sources of the Khrushchev and Brezhnev eras. It is interesting, however, that an emigrant, V. Fedorov, in a critical article about the Soviet space program, published by DER SPIEGEL in 1973, also refuted rumors about allegedly concealed cosmonaut losses. Only one name is mentioned—Yuriy Dolgov. But he, according to Fedorov's data, died while testing a space suit."

"It should be stated," Karel Patsner continued on, "that, over the 25 years that I have been traveling to the USSR, I have never heard anything like that from my own friends—scientists, cosmonauts and journalists. Even in conversations at midnight, when wine or cognac had loosened tongues and they talked to me frankly about launch delays, about details as yet unpublished about the deaths of the crews of the Soyuz-1 and the Soyuz-11, about the many accidents of rockets involving people and about the difficulties with the hush-hush moon project. However, there was not even a hint of tragedies involving unknown cosmonauts. As for accidents prior to the end of 1960, they can be ruled out if only for technical reasons. At that time, the Soviets still did not have a readied, tested spacecraft. In fact, the first satellite was launched in October of 1957. But fine, assume that I had not met with 'knowledgeable people' and that those launches were conducted in a special, supersecret sector, so that my informants could not know anything about them. But that is illogical because a tremendous amount of money would have been required to carry out two parallel programs. And the existence of the programs cannot be kept a secret among the specialists."

Patsner reported in detail about Ya. Golovanov's book "Kosmonavt nomer odin" [Cosmonaut No. 1], published in 1986. Discussed in it as well were rumors about our cosmonauts' catastrophes. Back in the spring of 1961, in an American weekly, there appeared a report that, several days prior to the 12th of April, a person had died in space and that Yuriy Gagarin was now playing his role on the ground. Later, in that connection, the name of V. Ilyushin, the ship Rossiya and the date—the 7th of April—came up. But Ilyushin had been in a serious motor vehicle accident back in June of 1960.

Does it not seem that the Hungarian writer was raising the old rumors to cause a stir?

On the other hand, Patsner still other weighty arguments. Dr. C. Sheldon—chief of the Research Division of the U.S. Library of Congress, until his death considered to be the greatest American expert on the Soviet space—wrote a report for members of congress in November of 1967: "Up to 1967, not a single country had lost a single crew during a space flight.... The stories that a lot of Russians had died in space are difficult to refute because they are so persistent and supplied with names and dates. Even such a prominent informant as O. Penkovskiy (an American spy—*Ed.*) wrote in his reports about those difficulties. However, American government employees has assured Congress several times that the United States did not have any information about such Soviet losses.

Even F. Klass as well, in the book "Taynaya strazha v kosmose" [The Secret Watch in Space], which is devoted to space-based espionage, has no doubts about Gagarin being the first. The network of American ground tracking stations along the Soviet borders and the reconnaissance satellites make it possible to follow all the flight preparations in the USSR. For example, President J. Kennedy knew about the successful launch of G. Titov in August of 1961 even before it was officially announced by TASS. In 1975, a law was passed in the United States regarding the declassification of old information from the intelligence services. M. Kassut, a writer, found nine documents in the CIA [TsRU] archives about the training of cosmonauts for the years 1960-1975. And in not a single one was there even a hint of any suspicions by the intelligence agents about secret Soviet space flights and catastrophes.

"I believe that I. Nemere is one of those authors who are trying to acquire money and fame from the wave of anti-Sovietism which has flared up in the former communist countries," wrote K. Patsner at the end of his article in defense of Gagarin.

"If, in 1960, you had published in the press that a cosmonaut training detachment had been formed and if you had given all the names of the candidates, is it likely that rumors would have arisen around Gagarin?" Patsner said to me.

"Karel, what do you mean 1960? Even in the 1980's, Komsomolka [KOMSOMOLSKAYA PRAVDA] could not have pushed through Yaroslav Golovanov's article 'Kosmonavt nomer odin,' where, for the first time, the truth was disclosed about that detachment. And, in order to publish the book of the same name in 1986, in the time of glasnost, you yourself wrote that Yaroslav needed the personal permission of one of the members of the Politburo."

"In the summer of 1964, S.P. Korolev vacationed in Czechoslovakia. Prior to that, Gagarin was here, he liked 'Golden Prague' very much and he talked about it a lot to Sergey Pavlovich. The chief designer was here incognito. He was not even registered in the guest book of the Czechoslovak Communist Party's Central Committee. When he was leaving, he said then to his entourage: 'When I come to Czechoslovakia next time, you will know who I am.' Korolev was opposed to the veils of secrecy, but.... There is nothing we can do, both you in the Soviet Union and we have to endure what has already died down in the West. The preachers, who have undertaken to cure the masses suffering from all kinds of illnesses, and the UFOs, which were of interest to a lot of

people there, but which are now of interest to only individual groups. Those same outdated sensationalisms...."

Mishin Discusses Western Perceptions of Early Soviet Space Programs

907Q0157 Moscow OGONEK in Russian No 34, 18-25 Aug 90 pp 4-5

[Interview with Academician Vasiliy Pavlovich Mishin, former chief designer of rocket-space equipment, by G. Salakhutdinov, candidate of technical sciences: "Once More About Space"; first paragraph is source introduction]

[Text]**We, the Soviet people, not without pride, consider ourselves to be involved in the research in the near-earth orbits. Even though we ourselves did not and do not know a lot of things—the system of "state secrets" has been at work. A conversation between Candidate of Technical Sciences G. Salakhutdinov and Academician V. Mishin, former chief designer of rocket-space equipment, touches on what was hushed up even until recently.**

[Salakhutdinov] Vasiliy Pavlovich, books have come out abroad whose authors touch upon matters concerning the development of our space program...

[Mishin] Yes, I know such publications. The titles alone are worth something! "The Russian Space Bluff," for example. The book was written by an emigrant, a former journalist of ours at one time, L. Vladimirov.

[Salakhutdinov] Well, then, what do you think about his allegation that along with the work of the Soyuz program there was a "shadow" space program whose objective consisted of misleading the Western community with respect to the level of our space technology?

[Mishin] There is more fiction than fact in that allegation. All operations then were subordinate to a single goal—the exploration of space. It is true that Khrushchev realized fairly quickly that our achievements in the space program could be used for political purposes. That is also why he kept demanding from Korolev more and more new successes. And that impatience began to be manifested right after the launch of the first satellite. We did not anticipate that it would have such an effect on the world. For all of us, it was just our usual work. But after the launch, Sergey Pavlovich [Korolev] sent his second deputy, L. A. Voskresenskiy, and me on a vacation for the first time in many years. We went to Sochi and stayed at Bulganin's country house. As I recall, I caught a cold there. Voskresenskiy, unable to stand the idleness, phoned Korolev in Moscow and received an order to return to the design bureau. We had to break off our vacation. When we showed up at work, it was then that we heard from Korolev about the first "political" desire of the head of the government: "Launch a dog by the October [Revolution] holidays."

[Salakhutdinov] Are you talking about Layka? How could you prepare its launch in such a short time frame?

[Mishin] Even earlier, back as far as 1951, we had launched dogs into space on high-altitude rockets. Dezik and Tsygan were the first ones launched to an altitude of more than 100 kilometers. So what happened is that we took the pod used for those purposes, put Layka into it and placed it into a satellite-craft. We managed to do it just in time for the holiday....

[Salakhutdinov] And the world gave you an ovation?

[Mishin] At first, yes. The foreign mass media wrote that the launch caused "astonishment and a commotion in the Western world." But something unforeseen occurred. The English Animal Rights Society raised a fuss. The fact is that no one had even considered returning Layka to the ground, and she died. When that became known, we were accused of cruelty.... Besides, we had so much of those "politics" in our country that.... In general, now, people don't feel right doing those things. Sergey Pavlovich was a unique person in the sense that he was, on the one hand, ideally suited to the administrative-command system that existed at the time; on the other hand, he could oppose it and do thinga in defiance of it. But in the face of those politics, even he was helpless. Khrushchev, more than once, hinted to Korolev that if he were to be overly obstinate, then Korolev would be replaced by Chelomey, whom Khrushchev liked.

So, we were under political pressure from the very first days of the operational space program. Khrushchev himself set the date for German Titov's launch. Several days after Titov's flight, they built the wall in Berlin. Western experts believe that the effects produced by the flight gave the GDR government a lot of moral and political support during the preparations for and the execution of that action. The experts also say that N. Khrushchev needed the first group flight so that, under the cover of the cheers, he could deploy in Cuba our rockets with atomic warheads. But, in the latter instance, I believe that the timing of those two events was simply a coincidence.

[Salakhutdinov] But what was the objective of the group flight? What was so special about it that could not have been done by, say, the Americans?

[Mishin] It was delicate business. In order for craft to be able to rendezvous in orbit, they had to be outfitted with approach equipment, the likes of which did not exist on either the Vostok or the Mercury craft. But we were conducting work on the Soyuz, while the Americans did so on the Gemini. Future craft were capable of performing those types of maneuvers in space. But the side that could develop its own craft first would become the leader...

The group flight...well, a day after launch, the first craft was over Baykonur. If the second craft were launched now with great precision, then they would turn out to be next to each other in space. And that's what was done.

Nikolayev's craft was launched on 11 August 1962, and Popovich's craft on 12 August. The craft turned out to be 5 kilometers from each other! Well, since, with all the secrecy, we didn't tell the whole truth, the Western experts, who hadn't figured it out, thought that our Vostok was already equipped with orbital approach equipment. As they say, a sleight of hand isn't any kind of fraud. It was more like our competitors deceived themselves all by their lonesome. Of course, we didn't shatter their illusions. But really, could the situation that took shape be considered a "parallel" or, what's more, "shadow" space program? That's not even disinformation.

[Salakhutdinov] The foreign experts believe that the second group flight in June 1963, by Bykovskiy and Tereshkova, was carried out in order to restore Khrushchev's prestige, which had been shaken throughout the world during the Caribbean Crisis. Was Tereshkova's launch supposed to, perhaps, evoke good feelings toward the Soviet Union from all the women of the world?

[Mishin] That's not true, either. The launch of a woman was the next step in our work. Of course, for his part, Khrushchev made maximum use of the world community's response. In one of his speeches, he said that Valentina Tereshkova's flight demonstrated to the entire world the equality of men and women in our country. It was naive, nothing more. No one thought at the time, Equality in what? In doing the most unprestigious, hardest work, or, as in this instance, in doing mortally dangerous work?

Whenever I see V. Mukhina's famous sculpture near the Exhibition of USSR National Economic Achievements, I catch myself thinking the same thought: why, this sculpture really symbolizes manual labor and the use of women in heavy physical work.

[Salakhutdinov] For greater realism, I would place a sickle in the man's hand and a hammer in the woman's, and then the sculpture would objectively reflect the position of women in our society.

[Mishin] Incidentally, let's take up that question now—what is a woman supposed to do in space? Tereshkova turned out to be at the edge of psychological stability. It would seem that her flight, on the contrary, should have discredited N. S. Khrushchev.

[Salakhutdinov] But what was the story with the flight of the three-seater Voskhod? It is known that the Americans were making the two-seater Gemini. Apparently, we decided to outdo them again?

[Mishin] Yes, that's what was happening. Khrushchev phoned Korolev and ordered the launch of three cosmonauts right away. But fitting a crew of three people, and in spacesuits, in the cabin of the Voskhod was impossible. So—down with the spacesuits! And the cosmonauts went up without them. It was also impossible to make three hatches for ejection. So—down with the ejection devices. Was it risky? Of course, it was. For approximately 20 seconds of flight prior to insertion into orbit, the crew did not have any means of escape in the event of an emergency. The idea of flying into space without spacesuits or ejection devices belonged to K. P. Feoktistov. He himself had gone aloft for psychological support of Komarov and Yegorov. The world applauded again. It was as if there was, sort of, a three-seater craft and, at the same time, there wasn't. In fact, it was a circus act, for three people couldn't do any useful work in space. They were cramped just sitting! Not to mention that it was dangerous to fly. But, in the West, they drew the conclusion that the Soviet Union possessed a multiseat craft. It would never have even entered anyone's mind there that we would send a crew into orbit without the appropriate means of rescue. It was good that everything turned out all right. But what if it hadn't? And even the two-seater Voskhod had also been made for the purpose of being the first. It was impossible to use it for anything, and it, too, had no ejection seats. But I would not call it purely "prestigious," either. All the same, the first walk by a man in open space had been tested, that's a fact. And it was performed by Aleksey Leonov. He was the first!

[Salakhutdinov] But the flight was extremely stressful? There were problems with the automatic control system, and the landing was manual, in the taiga, and there was a long wait in the freezing cold for the search group. What was the price of all those adventures?

[Mishin] There was a great deal of commotion both in the West and in our country. In general, as you know, our space program was treated kindly by the government. The impressive flights required great efforts and a corresponding amount of support, and they diverted manpower and assets from the work on the Soyuz. But only the Soyuz could provide real, and not imaginary, progress in the exploration of space. Of course, no one was working out any special program to later deceive the Western community. Each of the Voskhod's flights was aimed at achieving a specific objective in and of itself. It was pure chance that the aggregate of all those objectives created the opinion about the existence in our country of a craft for anything and everything! A large role in the birth of the myth was played by our notorious secrecy. We never said a word about how and by what method all those problems were being solved. The Western experts themselves came up with their own conclusion about something knew nothing about and couldn't know anything about. And that's how the myth came about.

[Salakhutdinov] Is it possible to say that we created myths and, in the West, they generalized them, as it were?

[Mishin] But we had no intention of creating myths! All the flights into space were a reality. The Americans, wish as they might, could not launch three astronauts; we had the Voskhod, which was somewhat more powerful than their craft, and, when the head of the government desired it, the Voskhod carried three people into orbit. We in fact demonstrated our own power. With that, we

achieved primacy in and of itself. Figuratively speaking, we had actually demonstrated in space unique circus stunts, each of which was interpreted by the Western "spectators" in their own way. Taken together, the stunts created the notion of the existence of a coherent program. There was no such program. There was voluntarism and its fruits.

[Salakhutdinov] Our Soyuz flew after the Americans had already completed their own experiments with the Gemini?

[Mishin] Yes, the Soyuz appeared after the Gemini. But, keep in mind, our program for the use of the Soyuz was more complex than the American program. It contemplated the docking of two manned craft and the transfer of cosmonauts in orbit from one craft to the other. But the Gemini program envisioned the rendezvous and docking with automatic "targets" only. Nevertheless, at that time, we were already lagging behind the Americans.

[Salakhutdinov] The Soyuz testing involved the tragic death of V. M. Komarov. There are quite a few rumors circulating throughout the world with respect to the Soyuz-1 tragedy. The foreign experts believe that we launched four unmanned Soyuz craft that had received the designation Kosmos with the numbers 133, 140, 146 and 154. And that problems arose in each of them. The English expert, Phillip Clark, for example, writes bluntly: "It is clear that the Soyuz was still not ready for a manned, and it is surprising that the testing program was not continued, since each unmanned flight yielded new problems..." How do you assess the results of such an expert opinion?

[Mishin] An expert opinion should be based on accurate initial data. But this Clark does not even know how many unmanned launches we had. That is really some expert opinion we have here!..

In all, there was but one unmanned launch of the Soyuz. One. It went satisfactorily. There were no serious failures. There was a special little plug in the heat shield, and it burned up. The unmanned craft landed in some lake and sank—water filled it up through the burned-out plug. The plug was not on the Soyuz-1 at all.

[Salakhutdinov] Don't you think today that, if there had been more unmanned launches, then the accident on the Soyuz-1 wouldn't have happened?

[Mishin] Prior to the flight to the Salyut-6 station of the Soyuz-33 craft with cosmonauts Rukavishnikov and Ivanov from Bulgaria, there were a lot of launches, both unmanned and manned. However, a serious emergency occurred during their flight: as they approached the station, the chamber wall of the main engine, which was used not only for docking operations, but also for the return to earth, burned through. The situation was complicated by the fact that a hot stream of gases was escaping from the chamber in the direction of the main fuel supply line and could have easily burned through it. If that had happened, the cosmonauts would not have been able to return to Earth. Fortunately, the backup braking engine still worked, although not at full thrust. When Rukavishnikov fired it at the prescribed time, no one knew whether it had managed to slow the craft sufficiently or not?

Why do I tell you this? Because the example shows graphically that accidents happen even on spacecraft that have been in use for a long time. The complexity of any technical system in and of itself is a precondition for a possible failure. And the specialists know that. The tests "catch" design and manufacturing errors only. The designer's job consists in seeing to it that a possible failure will not lead to the death of the crew. Contemporary space equipment is still such that there are "hot" spots in it—systems that cannot be backed up.

For example, the heat shield that protects the reentry vehicle from high temperatures, or the parachute system.

What happened during the Soyuz-1's flight? The launch went normally. And they were preparing to launch the Soyuz-2 with cosmonauts Bykovskiy, Khrunov and Eliseyev. The two craft were supposed to rendezvous and dock, and one of the three was supposed to transfer through space to the Soyuz-1; and then both craft would return to the ground. However, it turned out that one of the solar battery panels on the Soyuz-1 did not deploy. Would it have been possible to preclude that failure by increasing the number of unmanned flights beforehand?

No. The flight of the unmanned Soyuz indicated that there were no design errors here. Let's go on. Because of the emergency, the shortage of power on board caused a chain of problems—a change in the temperature conditions, complications in communications with the Control Center and difficulties in attitude control. But all those systems had backups. The star-tracking system did not work properly, because of inadequate power. But there were still an ion and a manual orientation system.

The trouble that arose did not lead to the cosmonaut's death. Vladimir Komarov managed to orient the craft and direct it to Earth. But then the fatal accident occurred—the parachute system did not work properly, the same one which had been used previously on the Vostok and the Voshkhod vehicles... Thus, we launched at least 20 unmanned Soyuz vehicles, and 20 times nothing bad happened, but on the twenty-first—a fatal accident. Those same Americans had so many emergency situations themselves! No matter what flight it was, there was a "surprise," a failure.

I will tell you something else. I was not certain that there would not be an accident on the Soyuz. Because no sensible person could not be certain of this. In principle. It is another matter that both I and the members of the State Commission, who gave the "go-ahead" to that flight, were certain that we had not left anything unfinished that would increase the degree of risk for Komarov.

All the systems on the Soyuz, except for the approach and docking systems, were the same ones as on the Vostok, the Voskhod and several special satellites—they had been tested repeatedly in flight. That's the first thing. Second, we had backed up on the Soyuz everything that could be backed up. Third, there had been one—the very first—test flight that had revealed only some weak points in the design and that had indicated that everything else worked normally.

[Salakhutdinov] But the Soyuz-1's launch was once again timed to a holiday! May 1, 1967 was approaching. You were, most likely, "pressured" from above, even though Khrushchev had been replaced by Brezhnev, right?

[Mishin] Truly, there never was a time when we worked in peace, without being hurried or pressured from above. The unskilled, totally bewildered, high-ranking bureaucrats believe that they are fulfilling their duty if they are shouting "Let's go, let's go!" at people who don't even have time to wipe the sweat off their brows. And the Soyuz program was complicated. But that has no bearing on the tragedy, inasmuch as it had nothing to do with the performance of the program.

[Salakhutdinov] Perhaps, in their haste, your subordinates committed engineering errors?

[Mishin] No, the deadlines and the pressure from above have nothing to do with that. Not a single supervisor for any of the Soyuz systems would have given the "go-ahead" to the flight if he were not certain of that system's satisfactory operation. In fact, the Soyuz was launched a week before the holiday. And that means that we could have even shifted the launch date to a few days later. Nothing was hindering us. And how much time is needed to pack a parachute? Hours! I am certain there was carelessness in packing it. Although I know there are other opinions as well.

[Salakhutdinov] Vasiliy Pavlovich, there are also the deaths of Dobrovolskiy, Volkov and Patsayev. What happened to them?

[Mishin] While they were making their reentry, a valve opened, connecting the cabin with the earth's atmosphere. Depressurization occurred. Under the conditions of the low pressure, the cosmonauts' blood boiled. The proverbial one-chance-in-a-million occurred. To be sure, that valve had been checked hundreds upon hundreds of times in test units and it had been used on all our previous craft. It had always worked fine. It never occurred to anyone that such a simple device could fail. Still, after the misfortune, we carefully analyzed the valve's design and discovered that there was an almost improbable, hypothetical instance when the valve could open sooner than the intended time. And it's that instance that led to the tragedy during the Soyuz-11's return to Earth.

[Salakhutdinov] Is it really possible that the designers could not come up with some means of ensuring its performance every time?

[Mishin] The whole point is that there were such means. During the depressurization of the cabin, the air rapidly escapes to form a vacuum. The cosmonauts should have heard a whistling noise—a sign of trouble. Someone needed to undo the restraining straps, get up and close the special valve. And it would even have been possible to cover the hole with a finger! The cosmonauts couldn't get their bearings. Perhaps, they were confused. Patsayev, apparently, grasped what was happening and he undid the restraining straps. But he was unable to get up. And the tragedy occurred.

[Salakhutdinov] A space flight, as far as I can judge, is made up of thousands of just such small things. And the price of each is frequently a human life. In January of 1967, three astronauts burned to death in an Apollo cabin: it turned out that there was damaged insulation on some temporary electrical wires, and one of the crew accidentally moved a forgotten wrench with his foot onto the wiring. There was a short circuit and a fire. The fire was put out in 15 seconds, but it was too late. Or another instance. An Apollo was descending to Earth, but Brand had forgotten to move two switches to the proper position, and the crew was poisoned by toxic fuel vapors. The death of the astronauts, so it would seem, was inevitable. Brand had lost consciousness. But Stafford found the strength to put oxygen masks on his comrades!

The last question. What would you, Vasiliy Pavlovich, do now, if you were in charge of the space program?

[Mishin] That is a big question that requires a separate conversation. But I will tell you briefly that, first of all, I would enlist economists, historians and philosophers in the new projects now. We would have to work out a new program for the exploration of space. And submit it for nationwide discussion.

[Salakhutdinov] Incidentally, in an interview for LITERATURNAYA GAZETA, Aleksandr Dunayev, the head of USSR Glavkosmos, noted that we have such a program. Is that so?

[Mishin] Dunayev is confusing a space exploration program with a plan of operations. Indeed, plans have always existed. They exist even now. But there is no program, and there hasn't been. Dunayev is justifying the manned flight to Mars, saying that that flight is also from the area of the development of the space program, but is it sound? I believe that, no, it is not sound. It is not clear why such a flight is needed right now. Do the people agree with its implementation? The expenditures will be enormous. And what will it yield in return? But Glavkosmos has already decided everything. By itself.

Another thing. Today, I would replace the entire administrative-command system, which has existed happily up to the present, with a system based on economic considerations. To this day, the enterprises of the various ministries working on the space program receive their funds from the USSR Ministry of Finance—directly. The chief designer, for example, does not have any levers of influence over those enterprises, even though he bears

the responsibility. There are an awful lot of chiefs among those working in the space program. The control structure must be reorganized. Of course, the methodology for controlling the development of the space program must also be changed. It is intolerable that even now it is geared to prestige and politics. And zero attention has been paid to raising the quality of life for the Soviet people. I will cite an example. American experts have calculated that, for example, in the USSR in 1987, some $30 billion were spent on the space program—more than was spent in all the other countries in the world taken together. The figure is enormous, but where is the return? In brief, the whole business of our space program is in need of serious restructuring. You could not list all the aspects here. If you're trying to catch up, you can't be in the lead. The time of prestigious projects and flights is a thing of the past. Space should long since have been working for the people of earth, for the lives of those who give to it their resources, their time and their talents.

Comments on N-1 Booster, Failed Lunar Program

917Q0005 Moscow IZOBRETATEL I RATSIONALIZATOR in Russian No 8, Aug 90 pp 20-21

[Article by Vad. Pikul, under the rubric "The History of Technology": "How We Conceded the Moon: A Look by One of the Participants of the N-1 Drama at the Reasons Behind It"; first paragraph is source introduction]

[Text] **With the transfer of the manufacture of the experimental engines of the N-1 booster to the series plant of the Ministry of the Aviation Industry, I was given the directorship of technical services for that somewhat unusual production line. I worked in that post until the flights of that booster ceased. I admit that to this day I feel bitterness over the unjustified shelving of the lunar program.**

The mid-1960s saw the development of practical interest in the "road" to the natural satellite of our planet. Only two countries could consider such an undertaking: the United States and the USSR. If one were to take only previous space achievements into account, it should have been a Soviet craft leading the way. However, that is not what happened. Moreover, our cosmonauts still have not had the opportunity even to fly around the Moon, although in the future the Energiya system is expected to make it probable that an expedition will land on the Moon.

So why do we lag so far behind the Americans in the conquest of that orb of the night? There are several reasons, and they are like strata at different depths in time. It is easiest to begin with an examination of events of 25 years ago. The then-chief designer, S. P. Korolev, and the individual who continued his remarkable work, V. P. Mishin, were, I think, headed in the right direction in that not very simple situation. It was through their vision and the efforts of the creative team they brought together that the huge N-1 booster was designed.

All three stages of its booster were designed to use kerosene and liquid oxygen. The reason for that was simple. Those rocket-fuel components and their combustion products do little harm to man and the environment. And as for kerosene, at that time in our country it was reputed to be the most accessible fuel for flight craft. We only intended to produce the higher-energy-content liquid hydrogen.

In short, the on-board fuel mass was unusually great. It is not without cause that the N-1 booster remains the heaviest of all the rockets ever constructed and tested. It should absolutely be included in the Guinness Book of Records. In order to compensate for the energy drawbacks of kerosene, liquid-propellant engines were provided for in a "supereconomical" version. They had yet to be developed.

The booster had a lateral configuration. During liftoff, only the lower power unit was in operation. The numerous small engines of that stage, much like a river pushboat, pushed ahead a cargo of several thousands of tons. The liquid-propellant engines of the second power unit were to switch on when the rocket was in flight, a couple of minutes after liftoff. And that would be above the ionosphere and after separation of the first stage. The reason for that persists even now. Less ozone is destroyed from contact with the plume. However, it is not just that.

The tall nozzles of the second power-unit engines make it possible in a vacuum to develop a greater thrust than that developed by ordinary (shortened) nozzles. At sea level, however, a tall nozzle of the circular form used cannot operate. Its broad, thin-walled shell cannot withstand the compression of external atmospheric pressure. In short, it loses strength and collapses.

The American S-5 rocket operated approximately along the same lines. That was the rocket that was designed to put the Apollo craft into a lunar orbit. In the transoceanic launcher, it is true, the kerosene was loaded into the tank of the lower power unit only. The second stage used liquid hydrogen, which the United States had no problem producing. The well-known German specialist Wernher von Braun headed the design of the S-5.

Not even a hint of the former American lag in space technology remained. And yet, there was still a chance for the N-1 booster to be the first to deliver a manned craft to the moon. We had to hurry. But the rapid completion of the design of the Soviet booster was hindered by the caprices of V. P. Glushko, the chief designer of the rocket engines.

At one time, relying on the ideas of K. E. Tsiolkovskiy and the von Braun designs of the wartime period, he had developed extremely reliable four-chamber liquid-propellant engines for a medium-class space rocket (the Vostok). To this day, those engines are toiling successfully, delivering Soyuz craft into near-Earth orbit. Of course, they have to work at the limits of their capabilities.

Involved in refining his creation and in trying to increase its thrust, Glushko went through a lot because of the perfidy of anergolic liquid propellant. Liquid oxygen caused special problems. Vibrational combustion! From time to time, it would destroy the structure without any warning. And indeed, the more powerful the liquid-propellant engine and the higher its efficiency, the greater is the probability of such an accident. The problem couldn't be solved properly, and the only way out that the engine designer saw was to abandon liquid oxygen and replace it with toxic nitric acid.

Neither the urgings of Korolev and Mishin to not abandon the oxygen, nor the protests of test specialists, who more than anyone else had to come into contact with the poisonous oxidizer, were of any help. V. P. Glushko stood his ground. But time was flying by. The general designer of aircraft engines, N. D. Kuznetsov, came to the rescue. His highly experienced group boldly undertook the development of an economical oxygen liquid-propellant engines of increased power. And they did it for all the booster stages and a fourth unit—the unit that was meant to provide the thrust impulse in the direction of the natural satellite of our planet.

After overcoming the virtually impassable debris of riddles associated with unstable combustion, the innovative engine designers in late 1967 proceeded to interdepartmental firing tests, at first using individual stands, then with the engines as part of power plants. February 1969 arrived. The first booster was on the launch pad, ready for unmanned flight. V. P. Mishin (Korolev was already gone) decided to break a bottle of champagne against the cold hull of the giant. The exhausting minutes of prelaunch commands dragged on.

The test launch left everyone with radiant hopes, although the rocket did not manage to remain in operation long enough for a separation of stages (the engines of the lower power unit were shut down at the half-way mark by a spurious computer command), but by that time the Americans had leapt forward. Two months before that N-1 launch, the crew of Frank Borman on Apollo 8 had made 10 revolutions around the Moon and had returned safely to Earth. But an expedition to the lunar surface still lay ahead.

The second round of the "duel" for the orb of the night was of brief duration and, again, did not come out in our favor. Work on improving the booster and its engines continued, but under different conditions. Rumors circulated about a possible shelving of the program, because now a lunar landing "was not urgent." The rumors multiplied and snowballed. Having been brought up in the administrative-command system, I believed practically blindly in the soundness of everything that came out of the system. However, when in 1974 a prohibition was issued on the launch of the vehicle assigned the arbitrary number "8," I doubted the soundness of such a decision.

After all, much had been invested in production, and we had had four unmanned launches. And during the last flight, the extremely complex first stage had been tested virtually completely! The operation of the more powerful lower "guy" just had to be reproduced in a similar fashion for the upper unit, the second and third stages. All hopes rested on the fifth launch, and it was to be done by "No. 8." Its power plants performed much better than deemed possible under then-prevailing engineering thought. The liquid-propellant engines were of a reusable design. Each of them had gone through firing tests on the stand.

Nevertheless, the rocket did not receive the go-ahead for transfer to the launch position! Nor did any explanations for the prohibition follow. I won't embark on the task of exhaustively characterizing, and commenting on, that decision by the higher-ups. The N-1 "phenomenon" still awaits study. But as a participant in that work, I can't help but express my opinion. The absence of Korolev hardly exerted a decisive influence. The country after the Khrushchev thaw, with its flights of fancy and shakeups, had already entered the zone of the "great stagnation." Financial resources were short, and our spending on the lunar program was about half that of the von Braun program.

We couldn't pass the United States, because of our reduced spending. After all, a great deal of money was needed. In terms of costs, the N-1 program was commensurate with the construction of the famed Trans-Siberian Railroad. And how about the time required? Let's recall. In May 1891, the then-time tsarevich Nicholas, being in Vladivostok, laid the symbolic cornerstone of the railroad. The construction of the railroad (the first phase) took a little more than 10 years. It wasn't until early in the winter of 1902 that the first train ran from Samara to Port Arthur. In other words, in terms of time, there is some similarity to the N-1.

However, the "rails" almost immediately began to pay for themselves! A successful launch of No. 8 could only sketchily outline any payback and would require new investments that would be both considerable and immediate. That's why the Brezhnev administration, I think, decided to quietly put the N-1 to rest. And the same for the lunar problem for the foreseeable future.

Anyway, little attention was given to public opinion back then. A vacuum set in! And if the participation of the higher authorities in the "smothering" of the lunar project got out, it wouldn't be good. How to create the appearance of concern about progress? A solution was found. They announced the construction of the Baykal-Amur Railroad and the opening of the new Energiya space program. Long-term construction projects don't require large sums immediately. And the construction project of the century also meant a new wave of resettlement of people and the broad use of the free services of both soldiers and prisoners.

The lunar project was, as it were, merged with the problem of developing a Soviet shuttle. Everything depended on the "versatility" of the future rocket system. And as for the fate of the No. 8 and other production stockpiles of the N-1 booster, it was suggested that V. P. Glushko, the director of the new program, take care of it. And he, as an avid opponent of the existing rocket system, ordered that all the materials be used for scrap metal. Many specialists were forced to say good-bye to their favorite job. No one has reckoned the losses from all those actions.

On the eve of those sorrowful events, many people who had taken part in the work in the lunar project (among them, the author of these lines) were presented with decorations. I admit that at that time I did not really understand why. It later became clear: we were decorated as a consolation and so that we would hold our tongues. It appears that at that time the chairman of the Presidium of the Supreme Soviet himself was not awarded the regular title of Hero of the Soviet Union. But one of his closest collaborators, who had undermined our work from above, was soon in the post of Minister of Defense. As they say, the facts speak for themselves.

In general, the N-1 booster had taken a great deal of vital energy out of the specialists. How the people lived and how they joked can be judged from one little episode. When the then-deputy chief designer of engines, N. D. Pechenkin, turned 50, his service friends gathered in his smoky office on a Saturday evening. Recognizing the weight of the job assigned to the celebrant, they presented him with a two-pood weight as a gift.

Unfortunately, not everyone was "charged for success." The opposition, formed by Glushko, did not remain idle, although up to 1975 it had advanced no alternative proposals. First the engines and then the design of their oxygen pumps were questioned. That also produced friction between the Ministry of the Aviation Industry, responsible for delivery of the liquid-propellant engines, and the Ministry of General Machine Building, where the booster and the craft were assembled. Nor did the passions of the moment escape directors of plants and institutes, military specialists and leaders of various ranks.

Accidents inevitable in finishing up work on a new vehicle were taken for the anticipated collapse. Passions were particularly inflamed after the major accident during the second launch, in the early morning of 4 July 1969. It was postulated that the oxidizer pump exploded on one of the engines of the lower power unit.

The officials endeavored not so much to get to determine what went wrong as to blame the opposing side. In such a complex undertaking, certain holders of engineering and academic degrees obviously lacked a range of vision and in some cases, even elementary literacy. It was not so simple for the program directors to work under such conditions.

But how would events have developed if the launch of No. 8 had not been held up? If it had not been held up, now in the lunar dust alongide the footsteps of Niel Armstrong there would be, I am certain, the imprints of the boots of our cosmonauts. And how about a flight around the orb of the night by a Soviet manned craft? It would probably have taken place before the 1980s. I won't even get into the notion that the N-1 booster was capable of lifting the winged Buran and putting it into an earth orbit!

They say that the stingy pay twice as much. He who pulls the blanket only onto himself is ready to give much more out of the public pocket. Before developing a clear-cut Energiya program and making maximal use of the experience of the No. 8, V. P. Glushko razed everything "down to the foundation." After wasting a number of years in a search for something unusual, he finally returned to oxygen, borrowed the idea for a gas generator from the N-1 engines and designed a booster that in its fundamental configuration was no different from Korolev's Vostok.

These days, we hear a lot about the virtues of the versatility of the Energiya booster. But that idea cannot be regarded as new. The design of No. 8 was also versatile. The latter was easily transformable into a launcher with a smaller lift capacity. Would it have been possible, for example, to launch the N-1 without the first stage, replacing the high-altitude liquid-propellant engines of the second power unit with the engines of the missing stage? In other words, it was costly for the country to put Glushko in as general designer of heavy rockets.

Involuntarily, one is imbued with deep respect for Korolev and Mishin, who took the first steps in the lunar epic poem, with no precedents to go on. Based on that, it is pleasing to see Academician V. P. Mishin, the well-known developer of space technology, among the winners of the IZOBRETATEL I RATSIONALIZATOR Prize. Good health and success to him.

Further Comments on Unsuccessful Manned Lunar Program

917Q0013A Kiev LENINSKOYE ZNAMYA in Russian 1 Aug 90 p 3

[Article by M. Chernyshov, Novosti Press Agency science commentator: "Why Were Soviet Cosmonauts not on the Moon?"]

[Text] This question is one of the least illuminated ones in the history of the Soviet space program. A shroud of secrecy had been thrown over the especially generally civilian program for two reasons: at first, the country's leaders, headed up by N. Khrushchev, were seeking to outdo the USA in the race to the moon no matter what and did not want to show their hand ahead of time, but, when it had become clear that the game had been lost,

the country's new leader, L. Brezhnev, and his entourage decided that the best way out of this situation was to pretend that there had been no competition whatsoever.

Now, individual materials on this topic are beginning to appear, but they are fragmented, often very subjective and, it seems, quite a bit more time will pass before all the troubles of this human and technical drama will be reconstructed.

The beginning of the sixties. The first cosmonauts are preparing for flights in the 5-ton Vostok vehicle, while, ripening in the developer of these Vostok vehicles, S. Korolev, the country's leading rocket expert, is the idea of designing a new, superpowerful launch vehicle capable of lifting into space even a 100-ton payload. On a ship with such a mass, two cosmonauts could be sent to the moon and, at the least, one of them would have the opportunity of being on its surface. Korolev and his associates well understood that it would hardly be possible to make a gigantic rocket straight away and, for this reason, they selected an intermediate version. In May of 1960, the decision is made: to carry out in parallel the designing of two large launch vehicles—the N-1, capable of lifting a payload of 40-50 tons, and the N-2, with a lift capacity of 60-80 tons. At this time, the Soviet space program was on an unusual upswing and people were full of enthusiasm and, therefore, the most optimistic deadlines were set: the first launch vehicle would be available by 1963 at least and the second by 1967 at the latest. It is true that there was no talk about the moon for the time being.

In April of 1961, Yuriy Gagarin was sent into space and it is approximately to this same time that the adoption of the decision regarding a manned circumlunar flight dates, but the landing of the crew on the moon was not being planned. This work was entrusted to yet another powerful space firm headed up by V. Chelomey. There they developed their own launch vehicles, the most famous of which is the Proton rocket.

With regard to Korolev's N-1, the deadlines for its development had been put off to 1965, while the work on the N-2 was limited just to the so-called preliminary design, in essence, just to the purely paper stage. Just what was the N-1, the enigmatic failure, about which, up to the present time, there are quite a few rumors? In general, it is a poor reminiscence of Korolev's previous rockets.

The N-1's lift capacity was increased to 95 tons. In the bottom stage, there were 30 engines. Is this good or bad? Some specialists assert that it is good because, even with a failure of two pairs of engines, the rocket could continue the flight, while others say that it is bad, inasmuch as it is difficult to achieve synchronous operation of such an unusual "package." The engines for the N-1 were designed by the famous aircraft engine designer, N. Kuznetsov. Involved in all in the development of the superrocket were 500 organizations from 26 ministries and departments, of which only nine were under the jurisdiction of the military-industrial complex. It is necessary to talk about this because departmental isolation, it seems, rendered a great disservice to the overall matter. And there is more. The ground stand base for testing the launch vehicle's components and the entire rocket as a whole, for all practical purposes, had not been established and hopes were pinned on testing everything during the flight tests. Even the very manned-flight program was changed repeatedly. In essence, there were two of them: a circumlunar flight in a Zond-type ship using Chelomey's Proton and a flight in an L-3-type ship with a landing on the moon using the N-1.

The first of them, in fact, was almost carried out to completion. Four times, the automatic Zond vehicles rounded the moon and returned to earth. It remained only to accommodate two cosmonauts in one of the ships and it would be possible to send them on the trip. But... the Proton, prior to this point, had never been used in manned flights. And, perhaps, most importantly, it was no longer possible to derive any kind of positive political effect from a circumlunar flight because, on the whole, the race had been lost to the Americans.

The country's leaders decided not to take the risk. And so the mission did not take place.

In the meantime, the work on the N-1 (L-3) continued. In February of 1969, the rocket was launched for the first time. Unsuccessfully. Because of a fire in the tail section, after 70 seconds, it stopped picking up speed.

In July of 1969, American Astronaut Neil Armstrong stepped onto the surface of the moon. But, just a bit prior to this event, the N-1 made a second attempt to set off on a flight. Because of a most powerful explosion, the entire launch complex was destroyed. During a third launch, in July of 1971, the rocket twisted and the engines worked only seven seconds.

The fourth and last launch in November of 1972 produced yet another disappointment: the rocket seemed to be going along normally but, after 70 seconds, there again followed an explosion in the tail section.

All work on the rocket and on the manned lunar program was finally stopped.

Survivors Recall 1960 Rocket Explosion at Baykonur

917Q0017 Moscow KRASNAYA ZVEZDA in Russian 24 Oct 90 p 2

[Article by Col. A. Radionov, under the rubric "The Time Has Come to Tell": "It Happened at Baykonur: At the First Launch of the New Rocket. How Marshal Nedelin Died. The Memory of the Living"; first two paragraphs are KRASNAYA ZVEZDA introduction]

[Text] **Thirty years ago, all the central newspapers published the sad news: while performing his official duties, Ch. Mar. Arty. Mitrofan Ivanovich Nedelin died in an**

airplane crash. And for a long time, the officers and residents of the Baykonur Space Launch Facility responded to all questions concerning that tragic event with a phrase cited from the newspaper.

But in reality, the disaster happened at the space launch facility itself. It went like this.

On 24 October 1960, the 41st pad was being prepared for its first launch. The rocket, which had been developed by the design bureau of M. K. Yangel, was also fundamentally new. After tests in the assembly and testing building, they hauled the rocket out on 23 October and set it up on the launch pad. The launch was scheduled for 1700, but for technical reasons it was postponed. A fuel leak was named as one of them.

Captain Stanislav Nikolayevich Pavlov, the launch group chief at the time, recalls:

"I did not see any fuel spillage. The fueling pipes passed through the erector, whose operation I was responsible for. The pipes had joints in them. There was a little dripping from them. We tightened them up. Drops of fuel got on the rubber gloves and made little holes in them. At the time, we didn't attach any importance to that, but later we found out that it was dangerous."

The last words come out with difficulty for the man. The dramatic events of 30 years ago still live in his mind, as if they had happened just yesterday.

That October day did not portend any disaster. It was clear and warm for autumn. The usual work on the preparation of a rocket for launch was under way. The actions of the operations crews were being observed by officers standing in formation at the edge of the pad—graduates of the F. E. Dzerzhinskiy Military Academy, who in the not too distant future would be heading the same kinds of crews. At the announcement of 30 minutes to launch, they and the emergency rescue services left the launch pad. The engineering personnel were also preparing to leave the pad. But precisely at that time, the first launch delay followed, and after it a second one.

"I was 15-20 meters from the rocket," Pavlov continues. "It was time for me to pull back the erector and the rocket dolly. The deputy chief of the Main Directorate of Rocket Forces, Maj. Gen. Aleksandr Grigoryevich Mrykin, Chief Designer Mikhail Kuzmich Yangel, and the chief of the combined rocket section, Col. Aleksandr Sergeyevich Matrenin, were at that time in a bunker at the command post, which was connected to the launch pad by a concrete walk.

"The marshal and a representative from industry—I think it was Grishin—were discussing the situation as they walked between the ramp and the rocket—that is, they were 10-15 meters from the rocket. The time was 1845.

"When I heard the rumble of the firing of the engines, I knew that something had happened. The pad was engulfed in flames and smoke. The first thing that came to my mind was that 'this is it, the end.' The velocity of the flow of the fiery cyclone coming out of the nozzle of the rocket is 3,000 meters a second. You can't run away from it. I automatically raised the collar of my jacket and dashed along the concrete toward the bunker. The wind was blowing in my face, and that's what saved me—the fuel fumes had not reached me. Apparently, I was the first person who was saved. People sprang toward me from the bunker. One of them began to knock the flames off of me."

Pavlov had enough strength to get to the staff barracks and look into a mirror. The soldiers parted in front of him with horror on their faces. Staring at him from the mirror was a completely unfamiliar, soot-black man with eyes overflowing with agonizing pain. Captain A. Funtikov from the fueling group sat him in the staff Pobeda vehicle and took him to the medical unit. Pavlov still remembered how they cut the boots off his burned feet and took off his outer clothing, which had remained intact under his jacket, which had been reduced to ashes.

Much later, in the Burdenko Hospital, he learned that Grishin, who had been with Nedelin right next to the rocket, had managed in some incomprehensible way to jump over the high railing and run across the molten tarmac and had even managed to jump to the high gate of the ramp from a height of 2.5 meters, breaking both legs in the process. He died in that same hospital from the burns he had received. Pavlov himself was unconscious for three days and was listed as missing, until he was able to give his name.

He was the first of the casualties to enter the hospital of the capital and the last one to leave it, after a year. A record of the serious injury was entered in his personal file only in 1988, when he was discharged to the reserves with the rank of colonel.

They learned of the explosion of the rocket at the headquarters of the space launch facility. The chief of the telemetry laboratory, Sr. Lt. Boris Ivanovich Klimov, who was closer than the others to the site of the accident, received a command: take 30 soldiers in three trucks and report to General Mrykin, who, after assessing the situation, issued the order to find everything that could have remained.

Klimov talked about carrying out the unpleasant mission:

"Driving up to the pad, I saw that we would not be able to manage without gas masks. But even with them on, it was impossible to work. Only after the toxic fuel fumes had scattered did I and my men begin to carry out the order. The dead were not identified visually, but from typical personal belongings, like keys from apartments. The tragedy at the space launch facility cut short the lives of 165 people."

Today, in attempting to make a critical evaluation of the events of 30 years ago, several publications are assuring the public that the blame for what happened supposedly

falls on Marshal Nedelin, who, according to their assertion, ordered the preparation for launch of the faulty rocket to continue, for the sake of the political goals of N. S. Khrushchev. But was that the case in reality? In how much of a hurry were the Chief Designer and the chairman of the State Commission to report the launch of the new rocket by the October holiday?

Here is what Pavlov says about that:

"Being a captain, I, of course, did not know what they talked about at the meetings of the commission, but at the space launch facility, there reigned an atmosphere in which even the slightest malfunction was studied carefully. And if in the situation that existed, the question of whether to launch or not to launch the rocket had come up for Nedelin, the response would have been unequivocally negative. Yangel, too, always reminded us of that: 'Don't rush, we need high-quality work. If you've made a mistake of some sort, under no circumstances should you conceal it. We are perfectly willing to suspend the launch until we get to the bottom of things.' And as I remember, there were such cases. Operations on a fueled rocket were, in principle, prohibited, but on 24 October 1960 no one doubted the feasibility of launching the rocket.

"Only many years later did I learn from friends that in the control and guidance system there was an extra, parasitic "circuit," and during one of its operations the valves of the second stage were opened and its engine was fired. The fiery jet burned through the fuel tank of the first stage, which led to the explosion."

That is how the tragedy occurred. The mistakes of past years have been taken fully into account. The launches of military rockets have now become "unmanned." But to this day the monument erected at the entrance to the space launch facility reminds us of the tragedy.

Today, as in past years, the participants who survived those events will gather at the space launch facility.—in order to recall again what for 30 years could not be talked about aloud.

Details of 1960 Rocket Explosion, Death of Marshal Nedelin

917Q0025 Moscow RABOCHNAYA TRIBUNA in Russian 6 Dec 90 p 4

[Article by S. Averkov, scientific associate at Yuzhnoye Scientific Production Association, under the rubric "Top Secret": "Explosion at Baykonur Cosmodrome: Only after 30 years are we learning the truth about the death of Marshal Nedelin and a large group of rocket specialists"]

[Text] *"From the CPSU Central Committee and the USSR Council of Ministers*

The CPSU Central Committee and the USSR Council of Ministers with deep regret announce that on 24 October of this year, while performing his service duties, Ch Mar Arty Mitrofan Ivanovich Nedelin died as a result of an aircraft accident. He was a CPSU Central Committee membership candidate, deputy of the USSR Supreme Soviet, Hero of the Soviet Union, deputy minister of defense, and commander-in-chief of the USSR Missile Forces. Marshal Nedelin was one of the outstanding military figures and builders of the Armed Forces of the Soviet Union and an illustrious hero of the Great Patriotic War."—PRAVDA, 26 October 1960.

Such was the official version. And for almost 30 years after that, the truth was hidden concerning the tragic events at the Baykonur cosmodrome.

Yes, a terrible accident happened. But it was not an aviation accident at all. And it took not only the marshal's life, but also the lives of many rocket specialists. How many individuals perished? Today no one could even begin to answer that question precisely. Some say 165, others say 200. Many were even buried in different parts of the cemetery so that no one would think that, God forbid, all those people were burned alive by the same hellish flame.

"On 24 October 1960," recalls I. Koval, a telemetry specialist from the Yuzhnoye Design Bureau, "I had to adjust an antenna at the launch pad. It was set up near the rocket. Nedelin was sitting next to it on a chair. Two platoons of a combat unit came up to him in parade step. After the reports of the commanders the marshal rose, dressed them down for their slipshod formation, and ordered the platoons to be reformed and that the report be given again. Then he turned to the officers:

"You have come here for the first launch of an intercontinental ballistic missile that uses a new fuel that is extremely promising for operation in combat units. Your presence is an honor for you. You are the first to get experience in the preparations for the launch of this newest missile under real conditions. Therefore, be attentive at your work stations. As much as possible, develop the practical skills that will be needed in your own unit."

After dismissing the officers, Nedelin sat down. An hour remained before the launch.

The world back then was arming itself. And that included intercontinental missiles. By 1960, the United States already had Thors and Atlases. What did we have? A two-stage missile developed at the Korolev Special Design Bureau. Speaking frankly, it was not entirely suited for military purposes. Liquid oxygen was needed for the missile. But it would evaporate, which meant that replenishing the tanks took having an entire oxygen plant alongside the launch pad, plus tanks and a railway bed. It was simply impossible to hide them from an enemy.

The government decided to develop a new missile that would use a more acceptable fuel that would ensure secrecy. The development of that vehicle was assigned to the special design bureau headed by M. Yangel and to

the rocket plant (now the Yuzhnoye Scientific Production Association) at Dnepropetrovsk. The specialists at Dnepropetrovsk proposed that components with a high boiling point—dimethylhydrazine and nitric acid—be used as a fuel. The new missile was designated in the American classification as the SS-7. We will use that designation here, too.

In the autumn of 1960, the missile was brought to the Baykonur cosmodrome. Its debugging, as the specialists say, got under way. The mission was considered especially important. And M. Nedelin, deputy minister of defense, was named chairman of the state commission for testing the SS-7. The commission included major rocket specialists. M. Yangel was technical director of the testing.

V. Budnik, his first deputy at the time and now an academician of the Ukrainian Academy of Sciences and chief advisor to the board of the Dnepropetrovsk Institute of Technical Engineering, recalls: "Yangel was different from some of the other chief designers. He had faith in his workers. Others personally checked every nut, but Mikhayl Kuzmich engrained in his specialists a sense of responsibility: you are delegated the development of this component, and you are responsible for it. L. Berlin was responsible for developing the SS-7, and V. Kontsevoy was responsible for its testing. Those two were talented people."

Nedelin arrived at pad No. 41. The state commission under his chairmanship had fixed the launch date: 23 October, at 1700 hours. The missile was already in a vertical position. But for technical reasons, the launch didn't take place. When the propulsion units were being prepared, a cutoff valve in the first stage opened accidentally. It was decided to postpone the launch a day. The plans called for replacement of the valve and a full repetition of the check-out during that period. There was no time to spare. The government was in a hurry. The progress of the work was being monitored by N. S. Khrushchev.

Some specialists now express the opinion that the reason for the delayed launch was different—it was a fuel leak. They say that buckets of fuel were carried from beneath the rocket. And that almost gave rise to a tragedy.

"Of course, the fuel was leaking," says K. Luarsabov, lead designer for rocket-engine testing at the Yuzhnoye Scientific Production Association. "We were checking the initial state of each system with special programs—we were trying to preclude anything unexpected happening in the forthcoming flight. The protective membranes were blown away in advance in order to preclude even the slightest possibility that the fuel would not be fed to the engine pumps. And after that operation, a minor leakage of fuel through the drainage systems of the first-stage engines developed. The state commission looked at the situation and decided to continue preparations for the launch. The leak had no effect on the rocket's safety."

In fact, many today agree that that was not the problem. Some malfunctions had to be taken care of. But how would that be done? By being extra careful and draining the fuel to avoid an accident? Or by continuing the work with full tanks? Yangel consulted the specialists. They were of differing opinions.

"At Nedelin's suggestion, the state commission decided to continue the work with the rocket fueled," says V. Budnik in clarification.

Well, evidently, time in fact was urging him on. The marshal had in fact flown to Baykonur from another cosmodrome from which yet another rocket developed by the Dnepropetrovsk specialists was to have been launched. But there was a delay there as well. But they drained the fuel there. That was not done at Baykonur.

24 October 1960, 1845 hours. There were more than 200 specialists at the launch pad. The 30-minutes mark before launch had already been announced. And suddenly sharp claps resounded inside the rocket. After an instant, a flash of fire erupted from the second-stage engine nozzle. The powerful jet immediately ruptured the oxidizer tank. Nitric acid gushed out onto the concrete. Both the rocket and the launch structures were engulfed in a firestorm. At that moment, the motion picture camera that was to photograph the launch was activated. The dispassionate film conveyed to us a frightful picture—people still alive becoming torches...

N. Myagkov and K. Luarsabov were working next to the rocket. They saw the flash. And they immediately began to run. The blast wave from the explosion knocked them down. It was as if a red-hot iron had fallen on Luarsabov's back. It set his fur jacket afire.

"I was standing near Nedelin," says V. Kukushkin, the director of one of the subdivisions of the Yuzhnoye Design Bureau, who miraculously survived. The air wave from the engine that had fired pressed the marshal against the concrete overhang of the roof near which he was sitting. The flame, apparently, reached him there. The explosion lifted me up and dragged me about 30 meters along the sidewalk."

Kukushkin's jacket and helmet caught fire. He found the strength to jump up and run. The blast waves overtook him, knocked him down again, slamming him against the asphalt. And nevertheless, those first 30 meters, a gift of fate, saved his life.

Why hadn't Nedelin left the launch pad and gone into the bunker? They said that for him the launch pad was the line of fire positions, as during wartime.

"Nedelin also sat near the rocket during other launches," recalls V. Budnik, "and when they advised him to withdraw, he answered, 'What's there to be afraid of? Aren't I an officer?' It's understandable, the circumstances were very intense at the time. Khrushchev was constantly phoning.

The rocket broke in half and fell on the launch pad, crushing those who were still alive. The flame flared up with new force. Gas cylinders were exploding, and the solid-fuel engines were firing. Some people were devoured by the fire; others, still running, were overcome by the poison gases. The specialists working on the erector boom remained hanging there. They were harnessed to it.

Yu. Yevteyev at that time was head of the emergency rescue team. It was the first to enter the fire zone. Those who were still alive were taken away in vehicles. When the fire weakened, work began on pulling out the dead bodies. Attempts at identification were from rings and apartment keys. There simply were no other traits to go by. All his life Yuriy Fedorovich has remembered his report to his superiors: "There's virtually nothing left..."

Yangel didn't recover soon from the tragedy. He was seen weeping at both the cosmodrome and back home in Irkutsk Oblast.

Long after, people were dying from burns and poisoning. Among the workers of the Yuzhnoye Scientific Production Association, the deputy chief designers of the special design bureau, L. Berlin and V. Kontsevoy, died as did the lead specialists V. Orlinskiy, Ye. Alya-Brudzinskiy and V. Karaychentsev and the young specialist L. Yerchenko.

As for the reasons of the tragedy, there are many versions. The most logical is the following:

"On 24 October," says N. Myagkov, a veteran of the Yuzhnoe Scientific Production Association, "it was decided to check the readiness for a repeat startup of the autonomous control system. The system's developers began to reset the electromechanical programming devices to their initial state. Those devices effect automatic in-flight transmission of signals and commands to the main rocket components, including the engines. Electric power was fed to the fueled rocket. The developers began the check-out. The devices, as they were supposed to, began to transmit critical commands. But provision was made for the appropriate blocking so that the signals and commands would not be executed. One of the blocks evidently did not work. The engine of the second stage was fired."

After the accident, a governmental commission under the chairmanship of L. Brezhnev convened. At the final session, it was announced that the government had decided not to punish those responsible. They had already punished themselves. And the obligation of the living was to bring the SS-7 rocket to fruition.

As early as in January 1961, the tests were continued in a hastily prepared second launching. At the end of the year, the new rocket was put on-line among the armaments.

Those who had perished were remembered the whole 30 years at the plant and at the cosmodrome. But only those who knew about the tragedy remembered. And the laying of wreathes on the graves took place almost with the classification "Top Secret." It wasn't until the autumn of this year that all the prohibitions were removed.

Recently Dnepropetrovsk aircraft landed at Baykonur. Veterans of the SS-7 tests met with one another. Those who had survived thanks to the doctors. A monument, a granite monolith, was set up in the area of launch pad No. 41.

"No matter how far we penetrate into the reaches of space, it must be remembered that here, on this pad, a step was taken—perhaps unsuccessful and failed, but nonetheless a step on the path to space," said S. Konyukhov, acting general designer at the Yuzhnoye Scientific Production Association.

At the dedication of the monument were relatives of the deceased, and they finally learned the whole truth. On that same day a memorial plaque was installed on one of the buildings of the Yuzhnoye Scientific Production Association.

...Yes, a terrible accident happened. Now we know about it. We remember those who died.

Moscow Aerospace Exhibition Assessed Favorably

917Q0001 Moscow KRASNAYA ZVEZDA in Russian 28 Sep 90 First Edition p 3

[Article by Col. V. Baberdin: "Space and Commerce"]

[Text] No one specialist, perhaps, would attempt to sketch out what tomorrow will bring for the Soviet space program. The most advanced sector in the country is going through what are not at all its best days. And it has already become fashionable for people to criticize the space programs. And the criticism comes from people on all levels and regardless of competence. Yes, it is true, the sector is science-intensive and requires massive funding. Yes, it is true, we are not receiving and have not received the proper return on our investment in it. And that was largely prevented by the griffin of secrecy that stood guard over almost all the basic space technologies. But times are changing. The first Moscow Aerospace Show is a clear testimony to that.

The Zvezda plant, the ZIKh, the scientific production associations Energiya, Molniya, Yuzhnoye, Kompozit—all of them are enterprises and design bureaus whose activities were not fully clear just yesterday even to the journalists who covered space. And now here they are in full array and absolutely open at the International Aerospace Show.

I admit that I felt a kind of strange feeling at the presentation on the occasion of the Soviet-French Day of the Space Industry, as I watched the leaders of all our main space companies—general designers, production directors, whose last names only yesterday we were advised not to include in articles on space—come up to

the stage one after another, and as I heard them tell of the activity of their organizations. Moreover, I got valuable, practical information aimed at the specialist. Such things had never happened before.

And that's great—if a little late. But we are still learning to advertize our work, we are learning entrepreneurship. The result? I am convinced it will all happen. In principle, the first hints are already evident. There are the plans for joint commercial flights of Soviet and foreign cosmonauts, and the building of the spaceport in Australia, and the agreement signed with the Americans to launch eight navigational satellites with our boosters. The list could go on. The sale of information obtained from a military satellite equipped with unique side-looking radar, and advice made available, in particular, to the French firm Dassault with respect to the thermal design of a space system of the Hermes type. The placement of cargo in orbit with the full array of our booster rockets at the request of customers.

The French cosmonaut Jean-Luc Chretian needs no introduction.

"The situation in the world is such," he observes, "that the levels of financing of space programs will inevitably decline. And this is understandable. For there are reasonable limits dictated by the economic capacities. What holds promise for the future? A consolidation of efforts. Only together, through joint financing and the merging of intellectual resources will we be able to erect programs involving, for example, the creation and effective operation of such powerful space systems as Buran, Hermes, and Sanger.

"As a pilot-cosmonaut," he continues, "I am more familiar with questions involving the organization of manned space launches. And that is my main activity today. We are organizing a joint European Cosmonaut Training Center. In the beginning, we plan to train 16 individuals there—future pilots of the Hermes and engineers and researchers for the orbital stations. We are aware that for the time being we lack experienced teachers and instructors. We are thinking of inviting some from your Zvezdnyy Gorodok. By the way, we have already been visited by the director of the Gagarin Cosmonaut Training Center, Lt. Gen. Avn. V. Shatalov. Our entire French delegation is receptive to the idea of the broadest possible cooperation with the Soviet Union."

The desire to collaborate with us was evidenced by the remarks of members of space companies such as Aerospatiale, Dassault, Matra, Sagem, and Arianespace. I would say that the Moscow exhibition was a success.

Report on Visit of NASA Delegation to Cosmonaut Training Center

917Q0012 Moscow PRAVDA in Russian 19 Oct 90 Second Edition p 5

[Article by Yuriy Krikun and Pavel Mukhortov, spaceflight candidates from USSR Union of Journalists: 'Space Ladder"; first paragraph is source introduction; text callout reads "Our reporting station at Zvezdnyy Gorodok"]

[Text] **"I would like to be remembered as a person who attempted to find the first step on the ladder that will join our countries in space and will lead to the stars," said Richard Truly, administrator of NASA, in summarizing his visit to the Cosmonaut Training Center imeni Yu. A. Gagarin.**

But first there was familiarization with Zvezdnyy Gorodok. The administrator of NASA and the American colleagues accompanying him—who included Pattie Finarelli, head of the NASA Department of Foreign Relations; John Thomas, a representative of the U.S. Department of Defense; Ray Walters, in charge of NASA space policy; and Arnold Nicogosian, head of the Department of Space Medicine and Biological Research—had a fascinating tour. Their guides were V. A. Shatalov, head of the Cosmonaut Training Center, and other managers of the center—B. A. Dzhanibekov and Yu. N. Glazkov. They were extremely hospitable, providing the visitors more than just the opportunity to sit in the "Soyuz-TN" trainer, and Richard Truly, evidently recalling his younger days, threw off his jacket and "dived in."

The guests spent two hours at Zvezdnyy, looking around and becoming acquainted with the specialists. However, there were no business talks. But, to be sure, it was clear to us that something more than simple curiosity is behind such visits. Recall that the last time that such high-ranking guests visited the Training Center was way back in 1971. That's when the "Soyuz-Apollo" program was born.

But today, only a few years before the Freedom station is to go into orbit, the Americans are seriously concerned about the lack of procedures for preparing astronauts for prolonged space odysseys; indeed, as of today their experience consists of only three relatively long missions, the longest of which was a little more than 80 days. Quite frankly, that's a long way from the yearlong flight of Vladimir Titov and Musa Manarov. That is why the guests had eyes as big as saucers when they were introduced to Anatoliy Berezovoy, who worked for 211 days in orbit, and Anatoliy Solovyev, who recently returned from a space watch. The experience of their flight training is priceless.

And we are all for cooperation, new forms of which are dictated by the last decade of our restless century. It is too bad that in our country the impression has set in that for the time being neither we nor the Americans are ready for perestroyka with respect to the space program, and the old principle continues to prevail: common ideas, separate finances. But somehow they must first be brought together if there are serious intentions for a planet-wide Martian program.

The comments of USSR Deputy Minister of Machine Building Yu. N. Koptev about the importance that is

now being given in the United States to the development of manned spaceflight make one think. We've reduced our own program practically to this: one or two more budget cutbacks, which our elected representatives called for this past year, and we could end up on the sidelines.

One of us, removing from his jacket lapel a badge with a golden journalist's pen flying around the Earth, presented it to Mr. Truly as a symbol of the "Space for the Children" project, continuing the unique humanitarian program that was not completed in the United States, because of the tragic death of the teacher Christa McAuliffe in the Challenger accident. And, naturally, we were interested, as a first order of business, in whether there are plans for continuing this program in the United States.

"At some point in the future. But not now," said the NASA administrator, spreading his hands in a helpless gesture. "Unfortunately, the Challenger explosion pushed us way back. For several years, we didn't fly at all, and scientific problems requiring immediate solution accumulated. Although the idea of Christa's flight was personally very close to me."

"Mr. Truly, Soviet journalists are ready to devote one of the days of their flight to the memory of Crista McAuliffe and to relay from orbit the geography lesson that she had prepared for the children of the entire world. Could you supply us with the outline for that lesson?"

"OK. You will receive it," said Mr Truly

Issues In National Space Policy, Conversion

917Q0018 Moscow ZEMLYA I VSELENNAYA in Russian No 5, Sep-Oct 90 pp 9-15

[Article by Academician V. S. Avduyevskiy, Institute of Machine Science imeni A. A. Blagonravov, USSR Academy of Sciences, and Doctor of Physical Mathematical Sciences L. V. Leskov, Kompozit Scientific Production Association, under the rubric "Cosmonautics": "On the Space Program, Conversion, and Commerce"; first paragraph is ZEMLYA I VSELENNAYA introduction]

[Text] What is blocking the use of the high scientific-technical potential of our space program, and how can the efficiency of space research be increased?

A National Program Is Needed

The Soviet Union is the only one of the leading space powers that does not have a national program of space research and space hardware development. Of course, it is a question not of departmental plans (ZEMLYA I VSELENNAYA, No 4, 1990, p 8—*Ed.*), but of **a unified state program,** which after broad discussion would be approved by the USSR Supreme Soviet. This paradoxical situation is especially regrettable because it was in our country that the founder of cosmonautics, K. E. Tsiolkovskiy, formulated the first scientific program for space research and the practical development of space.

What conditions should that program meet in order to ensure the maximum efficiency of space research? First of all, the program should be assembled in the context of glasnost and open discussion among specialists and the public, as is customary in other countries, and not via narrow departmental, closed discussions, as is done to this day in our country. Specifically, the opportunities to publish materials on the problems of the space program must be broadened considerably. Suffice it to say that we are the only country among the leading space powers in which there is not a single scientific or popular-science journal devoted entirely to the space program.

In addition, decisions on financing associated with the most important areas of the program need to made on a competitive basis. Such is the generally accepted practice in the other countries conducting space research.

In order for a competition of projects to play an effective role, a sensible model for the evaluation of their efficiency needs to be constructed. Further commercialization of the space program is tied primarily to an increase in the socioeconomic efficiency of its individual programs. According to estimates of American specialists, the volume of market sales of space services and of the production of materials in the United States will reach $60 billion a year by the year 2000. It is difficult for the Soviet economy to make such estimates—the prices here are the result of planning directives, and they are a tool used by the state to manage the economy. It is hard to say what the transition to a controlled market that is outlined for the country economy will change. For now at least, as the vice president of the USSR Academy of Sciences, K. V. Frolov, believes, "the very same crises that have shown up in other sectors are being observed in space sectors: research efforts are often performed in a fragmentary manner, without any economic or commercial basis and without comprehensive analysis or coordination over the entire life cycle of given items; clear-cut economic mechanisms to encourage the transfer of aerospace technologies to the national economy are lacking."

Meanwhile, it is, in fact, the penetration of advanced technologies, new materials, and new equipment into the national economy that produces a particularly elevated technical and economic impact. The calculations of American specialists show that, as a result of such activity, every dollar invested in space research ultimately yields a profit of as much as $15. The Soviet space program, unfortunately, cannot boast of such achievements.

Space programs are science- and resource-intensive, and their implementation often requires the cooperation of a large number of actors and takes a long time. Those programs are financed through the state budget within established amounts, while the success of the programs depends on the achievement of the goals set in the

program itself. Such a procedure cannot stimulate the commercialization of space activity, because it does not take into account completely factors associated with socioeconomic and national-economic effects.

If those factors are to be taken into account fully enough, it is necessary to adjust the existing evaluation model by regarding the commercialization of space activity as of paramount importance. The corresponding ground support, as well as conversion, which is regarded above all as the use of the elevated scientific-technical potential of the space program in the interests of the social, technical, and economic progress of the national economy, should be taken into account without fail. Such a methodology, which is in keeping with recent decisions on the transition to a controlled market economy, would make it possible to eliminate the current conflicts between departmental and statewide interests.

The space program is a typical example of a system with limited resources, or, more simply speaking, with a limited budget. That is why those who draw up specific space research programs are often guided by the principle of spending as little as possible to achieve whatever goal has been set. However, if special significance is attached to commercialization and conversion when a national space research program is being formulated, preference must be given to another principle—**the principle of maximum efficiency.** In which case, relative effectiveness is determined on the basis of a cost assessment of not only the main results, but also those accompanying them, including the social, ecological, and economic impact of the implementation of the program.

The next criterion in the formulation of an optimum national space research program is **a sensible relationship between the areas** that ensure the accomplishment of current national economic tasks (communications, navigation, meteorology, Space-based remote sensing of Earth) and promising areas that at present are not producing a profit, but can in the future, such as the production of new materials in space; the creation of a permanent large-scale manned orbital complex, a prototype for a space-based solar electric power plant for supplying energy to Earth, an aero-space transportation system, and a research base on the Moon; and the organization of a mission to Mars.

Even without discussing those areas in detail, it is easy to see that the work in each of them is capable of producing a revolutionizing effect on society in a variety of spheres—technical, ecological, economic, and sociopolitical.

Conversion Is Not Easy

The conversion of space activity should not be taken to mean a simple change-over of a portion of the production capacities of the space complex to the accomplishment of national economic tasks and, therefore, the reduction of the financing of space research. Such an approach to the problem of conversion—if it were to become dominant—could lead to the gradual loss of the high scientific, engineering, production, organizational, and manpower potential at the disposal of the space program today. In the end, society itself would suffer from that.

The **concept of conversion** should take into account several **fundamental principles:**

1. The scientific-technical potential of the space program is a national property. We should not allow its decline or inefficient use.

2. We should establish a data bank on the scientific-technical and production potential of the space program that would be capable of ensuring the optimum channeling of the achievements of the space program and their maximally efficient use in the national economy.

3. In order to achieve the maximum efficiency of the processes of conversion, we need to formulate the organizational structure for managing them.

4. We need to properly design a system for setting the prices of the national-economic products that are manufactured at enterprises of the aerospace complex, in order to ensure simultaneously profitability of production and an acceptable level of prices.

Let us turn to the defense-related aspects of space research and their effect on society at present and in the future. Among a portion of the population there exists the opinion that the spending on such items is, to a large extent, unproductive and such spending should be the first to be cut back. Unfortunately, such a point of view has some foundation—suffice it to recall the ill-considered decisions to deploy Soviet SS-20 missiles in Eastern Europe or to build the Krasnoyarsk radar stations, which later had to be abandoned and which cost the country very dearly. In the future, such things must not be allowed, and an effective means for preventing them is well known—the normal democratic parliamentary procedure of approving a budget.

In general, however, providing a defense level high enough to guarantee the country's security has been and will remain a top-priority strategic objective. And here a very crucial role is assigned to aerospace systems. One should not forget that space reconnaissance systems constitute the primary systems for monitoring adherence to treaties on disarmament and reduction of the military potential of existing military blocks. And in that sense, the spending on the development and operation of such systems not only is completely justified economically, but also is making it possible to handle fundamentally new tasks associated with preserving peace for mankind.

The expenditures on space programs for defense, scientific, and national economic purposes in aggregate are not as great as is often thought: in the USSR in 1989, that spending, according to published data, came to 1.1 percent of the national income (6.9 billion rubles); in the United States it came to 1.8 percent ($29.6 billion).

From those figures, by the way, it is evident how unfounded the hopes are of improving substantially the disastrous state of the economy of the country by "straightfoward" conversion, that is, the simple changeover of a portion of the production capacities of the aerospace complex to address directly national economic objectives. It is, of course, possible for enterprises that specialize in making rockets to master the production of pressure cookers, but, first, their net cost would more than likely be exorbitant, and, second, there still probably would not be enough of them. Meanwhile, numerous reports on the pages of the Soviet press make one think that precisely such an understanding of the conversion of aerospace activity suited certain segments of our administrative-command system to the greatest degree—it would make it possible to consolidate the existing departmental structure, which, to a large extent, has already become obsolete. Advocates of such an approach regard conversion not as a tool for equalizing the production and engineering potential and pulling lagging sectors up to the advanced level that has been achieved in the space program, but as an opportunity to reduce appropriations (meanwhile, solving the problem of conversion may require the opposite—increasing appropriations). That involves, as we see, choosing as the basic form of conversion simply the expansion of the assortment of products manufactured by enterprises of the aerospace complex—primarily, consumer goods.

In our opinion, such an approach is extremely faulty. First, it is ineffective, since it makes it possible to use the existing capacities only to a very small degree. Second, it harbors the danger of degrading the aerospace complex. The main focus of conversion should be the use of the scientific, technical, production, and organizational potential we have garnered and the quick and efficient transfer of advances to everyday national-economic operations.

The conversion of defense-related space activity can be launched only on the basis of the principle of reciprocity: if in the USSR the defense budget at present is being reduced substantially, in the United States that process thus far is just emerging. One must also not forget that the extent of conversion, based on the actual level of spending for space, cannot be particularly substantial—say, on the order of 1-2 billion rubles. With that, it is anticipated that about 60 percent of the production capacities of the aerospace complex will go to directly filling orders for national-economic sectors.

This concept of the conversion of the activity of the aerospace complex can prove to be effective only if the national economy absorbs, but does not tear away, advanced technology. Hence another mandatory condition—the thorough structural reorganization of the entire national-economic complex of the country as a whole, the decentralization of the economy's management and its changeover to a market economy, the genuine independence and full cost-accounting of enterprises, plus other measures that, for the present, are still being put into practice slowly and inconsistently. Thus, to sharply increase the national-economic significance of the aerospace complex will require, first of all, a thorough structural reorganization of all societal relations in the country.

Based on the above approach, how is one to regard the work on the Strategic Defense Initiative (SDI), which is being vigorously pursued in the United States, and our own "responses," which our press is reporting only in vague terms? There is no need to repeat what has already been said about the extreme danger of that work, which focuses on an attempt to upset the military strategic parity that exists in the world. Let us examine that question from a different angle: after all, SDI also represents a breakthrough in the area of fundamentally new, advanced technologies. Their use in the national economy would make it possible in the future to raise production-and-engineering potential to a substantially higher level. There is also another, by no means unimportant, aspect of the problem: the aerospace complex itself, by performing that work, not only is maintaining but is also raising its own scientific, production, and manpower potential—and as a result of that, society as a whole again turns out to be the winner.

It would be a mistake to take what has been said as a vindication of SDI. It is a matter of something completely different: society should be interested in supporting work that is on the same scale as SDI, but, it goes without saying, lacks its characteristic shortcomings and dangers. Problems that satisfy those requirements do exist, and defining them in practical terms becomes particularly effective if there is broad-based international cooperation. Several of those problems have already been named: a mission to Mars, a research base on the moon, global space monitoring, an orbital information and production complex, a prototype of an orbital system for supplying energy to Earth, and so forth. An international agreement on the launching of work on any of those objectives would theoretically make it possible to refocus to that new, promising area a portion of the potential of the aerospace complex, which is concentrated at present on SDI, and thereby to decrease the level of military confrontation in the world, to strengthen the security of civilization, and to promote the pooling of the efforts of mankind in solving the serious global problems facing it.

Competition and Cooperation

Regardless of whether decisions will be made on work on any of the large-scale promising projects, the continued acceleration of efforts in the area of international cooperation represents a substantial reserve for increasing the national-economic efficiency of our space program. In recent years much has been done in that area in the Soviet Union, particularly since Glavkosmos USSR was established, in 1985.

Glavkosmos USSR is offering launch vehicles of various classes to foreign consumers for commercial use. It should be borne in mind that a world market has already

sprung up for the launch of spacecraft (mainly into geostationary orbit). It is anticipated that in 1989-1996 no fewer than 110 communications satellites worth $5 billion will be launched. On the world space market, the Soviet Union is faced with serious competition (the West European consortium Arianespace, the private American corporations Martin Marietta, General Dynamics, and McDonnell Douglas, the Chinese state company Great Wall). In the conditions that exist, marketing—the comprehensive adaptation to the needs of potential clients—is acquiring very great importance.

In assessing our prospects on the international space market, one must also bear in mind both the lack of appropriate practical experience and the fact that the competitive ability of Soviet proposals is being greatly restricted by the activity of COCOM—an international organization that monitors the delivery to the territory of the Soviet Union of nearly 300,000 different items of equipment and materials produced by the United States and its allies and partners.

In the West, the internationalization of space research has become a fact. Work on the development of the American orbital station Freedom is being performed on the basis of the international division of labor. The national space agencies of the United States, the countries of Western Europe, Canada, and Japan are cooperating within the framework of the program Mission to Planet Earth. The purpose of that program is to perform basic research associated with the Earth's surface, including a study of the results of anthropogenic activity and relationships in the biosphere and the evaluation of the ecological situation. More than 100 countries belong to the international consortium Intelsat, which is engaged in the development and operation of a global satellite communications system. Another international organization, Inmarsat, supports the operation of a maritime satellite communications system.

For now, the Soviet Union is involved relatively few international space organizations (the Inmarsat consortium, the international organization Intersputnik, and COSPAS-SARSAT—a space-based system for the rescue of those in distress). Interesting experiments prepared with the participation of foreign specialists have been conducted within the framework of the Interkosmos Council of the USSR Academy of Sciences. However, the Council thus far is not an organizational and scientific-methodological center that ensures an amply great effectiveness in the conduct of scientific research in space.

And the last thing. Raising the efficiency of the domestic space program in terms of the national economy depends on many of the factors examined above. It will hardly be possible, however, to put all those factors to use, if the appropriate measures of organizational support are not effected. The combination of departmental monopolism and, at once, departmental isolation, which is typical today of the organization of work in the space program in the USSR, must be overcome.

It would seem that the subdivision of the enterprises of the aerospace complex, their changeover to leasing conditions, and the establishment of interdepartmental and international associations could become an effective means of improving the organizational structure of the aerospace complex. The formation of a State Committee of the USSR Council of Ministers for Space Research would help to bring some order to the financing of the operations in the space program that are being performed by the Academy of Sciences, the Ministry of General Machine Building, and other sector ministries and departments.

Deputy Minister Refutes Claims of USSR Space Expenditures

917Q0004 Moscow EKONOMIKA I ZHIZN in Russian No 38, Sep 90 p 19

[Article by Yu. Koptev, USSR deputy minister of general machine building, under the "Glasnost vs. Rumors" rubric: "Space Fantasies"; first two paragraphs are source introduction]

[Text] **Our attentive readers N. Lakhvich (Minsk) and Ye. Dyukarev (Pavlodar) have pointed out a discrepancy in the published estimates of spending on the space programs. "The articles in the newspaper TRUD and the weekly ZA RUBEZHOM," they write, "assert that the USSR spending on space technology has always been greater than the that of the United States and the European countries taken together. In your weekly, the article 'The economics of space: At the cutting edge of the problems' cites different data. Which are more precise?"**

We asked the USSR deputy minister of general machine building, Yu. Koptev, to respond to the question of the readers.

Let me say at once that I have no particular comments to make about the spending of the United States and the European countries. But everything relating to the expenditures "on space" in the USSR is clearly fiction! It may or may not be premeditated, but it's still fiction. Although the pieces in TRUD and ZA RUBEZHOM were based on data from a reputable international consortium, the European Space Agency, the expenditures listed for our country were exaggerated severalfold.

In my view, there are several reasons for the error. One possible motive is the desire to "goad" us into refuting those figures and publishing our own data on the spending for the creation and operation of space systems. Well then, let us respond to the gambit.

The chairman of the USSR Council of Ministers, N. I. Ryzhkov, has already stated, in a report to the USSR Supreme Soviet in 1989, that our spending in space technology amounts to 6.9 billion rubles (R). Adjusted to

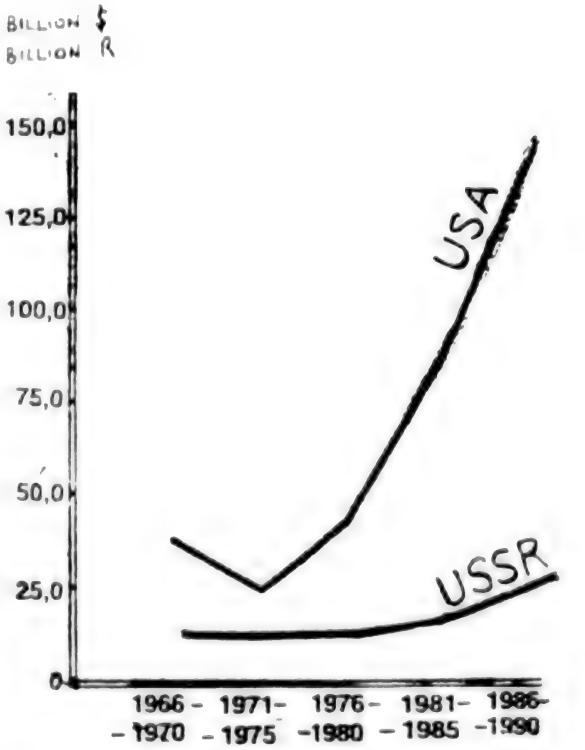
the official rate of exchange, that's around $10 billion—nowhere near the $35 billion claimed in the West.

Perhaps the 3.5-fold overestimate is due to an incorrect procedure for estimating our spending on space. Or maybe the authors of the calculations, using an acceptable procedure, started from erroneous initial assumptions. We can't rule out the possibility that the gross error in the calculations was due to a pursuit of the interests of the moment—a well-developed process that has borne fruit on more than one occasion in the past. The fact is that comparative figures have always had quite a lot of influence on the governments and parliaments of the West in the distribution of budget appropriations. And if there is constant talk that the USSR is spending much more on this or that defense-related task, one can count on getting what he wants. And since our figures are not published, the soil has always been fertile for arbitrary estimates.

By the same token, we cannot rule out motives associated with a competitive struggle. The achievements of the USSR in the field of space technologies have great commercial importance and competitive value. And the publication of articles like those that evoked the surprise of the readers may also have an effect on our parliamentarians. After all, a cutback in budget appropriations will have a negative impact on scientific-technical progress in our country.

It is a great misfortune that a rather broad segment of the public has in its mind an erroneous stereotype that depicts the space program as something that is detached from the economy and whose development is dictated solely by the political, propagandistic, military and mythological ambitions of individuals or agencies. This is absolutely false, but a kind of vicious circle is created. No one says we don't need space-based systems of communications, meteorology, or geodesy, space-based methods of mineral prospecting and observation of the Earth's surface, including observation for military purposes. No one doubts the need to perform scientific research in space. The paradox lies in the fact that those components are generally lumped together under the term "space program," which gives people the erroneous impression that it is a detached structure.

The oft-heard phrase of cutting back on spending for space is not addressed to anyone in particular. There are centralized expenditures of the government for the creation of the space systems for various sectors of the economy, science and defense. The need to centralize those expenditures stems entirely from the multipurpose, universal nature of the elements of the aerospace complexes (launch, measurement, and testing units, boosters, upper stages, etc.). It is not easy to determine the full range of clients and consumers of information or their share of involvement.



Today, our spending on the aforementioned space systems is made up of four areas. There are the expenses associated with the scientific-research and experimental-design work done in behalf of all the areas that use space technology; those associated with the production of that technology (including technology on order from the USSR Ministry of Defense); the operational expenses (in large measure, through the USSR Ministry of Defense); and the expenses associated with capital construction of the production, experimentation, and testing base (spaceports), the systems for controlling space complexes and the data-processing and receiving stations. Around R80 billion, at current prices, have been spent for those purposes over the entire period in which the country's space systems have been created and used (a period spanning more than 30 years).

The graph that we have made shows U.S. and USSR spending for space technology for various periods of time. (The spending by the United States is given in dollars; that of the USSR, in rubles. Anyone wishing an adjustment to a single measure should use the rates of exchange current for the given periods of time.) It follows from the graph that the spending of the USSR on the creation and operation of space systems has never exceeded that of the United States; on the contrary, it has always been much lower. And if any type of exaggeration is permissible in science fiction, in economics accuracy is a virtue.

U.S. and USSR Expenditures on Space, 1966-1990

Years	USSR (billion R)	U.S. (billion R)
1966-1970	7.9	31.5
1971-1975	9.5	23.7
1976-1980	12.2	35.6
1981-1985	22.7	78.2
1986-1990	31.6	139.4

Head of Planeta NPO Criticizes Space Program Organization, Planning

917Q0048A Moscow IZVESTIYA (Union edition) in Russian 1 Feb 91 p 2

[Interview with USSR Pilot-Cosmonaut V.V. Aksenov, twice Hero of the Soviet Union and head of the Planeta Scientific Production Association, by IZVESTIYA science commentator B. Konovalov; date and place not given: "A Space Agency Is Needed"—first paragraph is IZVESTIYA introduction]

[Text] Do our space programs have a client? The man on the street will hardly answer this question. After a moment's thought they can voice various opinions and name many organizations. We asked this question to a well-informed man—USSR Pilot-Cosmonaut V.V. Aksenov, twice Hero of the Soviet Union. A year ago he took charge of the Planeta Scientific Production Association, which has now united in a single whole the tasks of the development and operation of instruments, satellites, and a system of ground stations of the receipt, processing, and transmission of space information on the state of the atmosphere, dry land, and ocean to all users.

[Aksenov] If you do not touch on the military part of astronautics, Aksenov says, a quite involved situation appears. In the space programs on meteorology, ecology, and the study of natural resources the clients and producers are separate. The USSR State Committee for Hydrometeorology and the USSR Main Administration of Cartography order and operate the systems, while the Ministry of General Machine Building (MOM) and other industrial departments produce the hardware. The picture is the same in purely scientific programs that are being carried out under the aegis of the USSR Academy of Sciences. But in the manned space program, on which the "lion's share" of the assets being allocated for national economic goals is being spent, the same department—the Ministry of General Machine Building—is both our client and our producer.

It was specified as the department which is responsible for the introduction of the results of space programs in various sectors of the national economy.

Today the majority of assets for national economic space programs are allocated directly to the producer in the Ministry of General Machine Building, which realizes them in space hardware—the Mir station, its special-purpose modules, and other apparatus. There it is specified what equipment will be installed and where the obtained results will be sent—to the USSR Academy of Sciences, sectorial departments, institutes, and other organizations.

But since the results are transferred free of charge, the consumer is not able (and often also does not want) to demand more, while the hardware producer always has the right to say that there are good achievements. A kind of equilibrium of irresponsibility is established, and the well-known system of the dictation of the producer over the consumer is implemented.

[Konovalov] But what is it necessary to do from the standpoint of common sense?

[Aksenov] It is necessary to establish and fulfill each program as a package, with a clear understanding of the end result.

As a package means: First the specific tasks, which are worked on by the program, then the composition of the onboard equipment are determined, and then available space hardware is selected or space hardware is produced anew. And this is still not everything—the resultant ground unit for the assimilation of the obtained space "intermediate products" should be determined and supplied without fail, including with financing.

It is then that it is possible to consider the complex finished. But only the client of a program or system can do all this.

[Konovalov] Can you cite a specific example of the development of hardware, which an objective client would not finance?

[Aksenov] By all means. At present the new Priroda special-purpose module, which is intended for the study of earth from orbit, is being prepared for the Mir orbital complex.

At the discussion of the program of this module at the USSR Academy of Sciences was asked the scientists who were advocating its launching: Is there a list of specific scientific tasks that will be accomplished by means of the equipment of this module? It turned out that there was no such list, but there were general ideas—what institutes of the USSR Academy of Sciences could use its results. Then we asked: Has it been calculated what time in orbit the proposed equipment should operate in order to provide reliable results? They even took a little offense at us: Over an entire year something will be obtained, is this really incomprehensible?... Hence, even in the 1990's, and not in the 1960's, they are guided by the principle: "Perhaps we will obtain something."

An even more surprising picture is revealed upon acquaintance with the composition of the planned equipment.

On the manned complex within the Priroda special-purpose module nearly all the equipment is automatic equipment, which does not require the participation of man, while the results are dumped to earth via radio channels in the same way as from an automatic vehicle. The most efficient equipment—the high- and medium-resolution scanners, which are proposed for installation on the module—is operating at present on the Resurs automatic satellite and in 1991 will also be launched on Resurs and Okean satellites.

Moreover, on automatic vehicles the work can proceed on each revolution year round (the Resurs-01 vehicle has been operating continuously for 2.8 years), while within the station all the equipment, which requires precision orientation, is arranged in a long line for operation during the short intervals that remain from the operations which are necessary for the life of the station: dockings, loading and unloading operations, repair, time for physical culture, and so forth. And all of us are sincerely amazed: Why is it necessary to operate within the manned complex valuable automatic equipment, on the production of which vast assets are being spent? Manned programs, undoubtedly, are needed. Within them it is possible and necessary to do what automatic machines cannot do, and there are many such tasks. But the examined situation can arise only in the absence of the overall coordination of space programs and in case of results that have been promised free of charge to institutes of the USSR Academy of Sciences.

[Konovalov] We are now changing over to controllable market relations. In all countries with a market economy special space agencies have existed for a long time. They exist in the United States, France, Japan, and Western Europe. These agencies receive money from their states for space research and bear responsibility for its most efficient use. Is it, perhaps, also time for us at last to establish a space agency in the country?

[Aksenov] This was also clear without the transition to a market. The question of the improvement of the state system of the formulation of space programs, the determination of the priority of goals and tasks, and the obtaining of the desired results has been coming up for a long time. But this is particularly urgent today, when the task of the substantiation of requested assets and the objective evaluation of the obtained results has arisen.

The existing structure of the management of astronautics and its financing is very unwieldy and involved. There is needed today a state organ, and best of all a space agency, in order not to reinvent the bicycle, which would become the "head" of this entire branched system. Apparently, we will get in the end to the point that the USSR Supreme Soviet will decide how much money it is necessary to give to astronautics. It should be allocated to this agency, which will perform the role of the overall coordinator and the main client of space programs.

But owing to the great specificity and diversity of the directions of space programs the clients for the individual directions, who directly formulate their own comprehensive programs and submit them to the main state agency for consideration and financing, should be specified.

The clients for the directions should cooperate with industrial enterprises during the specific analysis of their comprehensive systems or programs and determine their acceptability for the fulfillment of a specific project on a competitive basis. The conversion of defense sectors and enterprises, which is under way in the country, is conducive to this.

There is another important circumstance. As a result of the restructuring of the state system of management and financing a portion of the specific regional problems will be solved at the republic, oblast, or even rayon level. Among these problems are all the regional tasks on ecology, the use of nature, and nature conservation and the programs of the development of communications systems—television, the establishment of telephone communication, the development of information systems, and so forth.

The accomplishment of all these tasks can be discussed among the space clients for the directions and the corresponding republic or oblast organs. Thus, the clients, while having the entire national and even international scientific and technical potential, should also accomplish specific tasks of the regions of our country, which to a significant degree will increase the overall effectiveness of space systems.

Interview With Former Chief of Cosmonaut Rescue, Survival Training

917Q0010 Moscow NEDELYA in Russian No 38, 17 Sep 90 p 13

[Interview with Iosif Davydov by Andrey Zhdankin, under the rubric "Page 13 Guest": "Iosif Davydov, Rescuer of Cosmonauts"; first paragraph is source introduction]

[Excerpt] All Soviet cosmonauts know him. He has seen and tested so much that it would be enough for ten lifetimes. A "technocrat" to his very fiber, he has written several books and hundreds of essays. He belongs to that breed of fortunate people who spend their entire lives involved in their favorite work. He is a rescuer. At the Cosmonaut Training Center, his last post had an unwieldy title: Chief of the Section of Systems for Emergency Rescue, Landing, Search and Training of Cosmonauts for Survival Under Extreme Conditions. Today Col Iosif Viktorovich Davydov (he recently went on reserve status) is the guest on page 13.

[Zhdankin] Rescuer of cosmonauts. A unique profession. How did you get in this line of work?

[Davydov] Vladimir Komarov gave his blessing for me to get into the work, and it was with his "introduction" that I ended up at the Cosmonaut Training Center in 1963. He was an astonishing man who was able to see what people had in them. By education I was an aeronautical engineer. I had graduated from electronics school, I flew a little in the Tu-16, and then I wound up at the Flight Test Institute. I was involved in aircraft tests, and that's where I became acquainted with Komarov. I did a lot of different things at the Center. I was in charge of the "docking" simulator, and then I became involved in the problems associated with survival in extreme conditions. The most important thing was to teach cosmonauts not to get into such situations.

[Zhdankin] According to official reports, landings go surprisingly smoothly. Aren't rescue workers left without work?

[Davydov] I was always "lucky," and I found myself at points where unforeseen situations occurred. I met 17 craft, and many of the landings were "not smooth." I managed to "prevent" at least 12 cosmonauts from being interred prematurely in the Kremlin wall: Lazarev and Makarov, Gorbatko and Glazkov, Gubarev and Grechko, Berezovoy and Lebedev, Zudov and Rozdestvenskiy...

[Zhdankin] What do "unplanned" landings look like?

[Davydov] Well, for example, the most severe case was that of the crew of Zudov and Rozhdestvenskiy. The flight got off to a bad start. It would have been one thing if it had been just one "piece of bad luck," but everything went that way. They had to set down prematurely, at night. The vehicle overshot the designated point by 121 kilometers and landed in the middle of the bitterly salty Lake Tengiz. Pitch darkness, a freezing 22 degrees, a strong wind and sludge ice on the lake. The parachute system got snagged, the craft capsized, the airholes ended up underwater, it was hard for them to breathe. A whole "bouquet" of extreme conditions. The lads were brave chaps and acted calmly and intelligently.

The helicopter hovered over the ship. I was the only one with a diving suit, and I pulled it on right over my uniform (there was no warm clothing). I was already seated on a strut, ready to descend. Thank God, I didn't have to, otherwise no one would have returned, the helicopter would not have had the power to provide lift. In violation of all instructions, the craft was towed in that position to the shore. The lads almost suffocated.

The landing of Gubarev and Grechko in the steppe was very difficult, with a wind of 25 meters a second. By happy circumstance, the craft obligingly landed in the only salutary place around—an enormous snow-filled pit. If it had landed anywhere else, it would have been dragged across the steppe, because the parachute didn't fire off. One can recall how Lazarev and Makarov "smacked" into the Altay and hung on the very edge of a cliff of the mountain Teremok-3. Being a cosmonaut is still a very dangerous profession.

[Zhdankin] How are cosmonauts trained for survival?

[Davydov] A group of specialists flies out to an inaccessible, completely unpopulated area (tundra, mountains, or desert). We transport there a reentry module with a deployed parachute. The cosmonauts are already in their spacesuits. The vehicle is placed in the most inconvenient conditions. In other words, we simulate fully an extreme landing. Extremely unpleasant "procedures." Because in real landings, extreme conditions are not at all unusual. Safeguards have been taken, and the loss of life during the training has been precluded; but the cosmonauts, of course, don't know that. The Americans don't simulate: the people are dropped in the desert and given water and the direction and the point where rescuers are waiting. If they get there, fine; if they suffer heat stroke and don't get there, say good-bye to your career as an astronaut.

[Zhdankin] Do the American rescue systems differ from ours?

[Davydov] They are similar. In fact, their water rescue is stronger, but systems are being worked out for deserts, jungles and cold areas. Training in the Air Force and civil aviation differ greatly. Pilots and stewardesses are trained to rescue not only themselves, but also the passengers. The training of a flier costs 6-7 million. They are the most valuable military specialists, virtually the pride of the nation.

[Zhdankin] In order to teach someone else, do you have to learn it first yourself?

[Davydov] Absolutely. The testers have done it all themselves under more severe conditions.

[Zhdankin] What testing have you personally had to do?

[Davydov] A full course in survival science. I've sat in a reentry module for 12 hours in bumpy air. It takes everything out of you. I've spent many hours "sitting it out" in an isolation chamber, in a heat chamber with temperatures of +80°. I've been dragged through a forest—that was in simulation of evacuation from forested areas by helicopter. And experiments in the desert! Once with another person, Slava Perfilkin, I underwent a body dehydration experiment. The last seven hours left were the most difficult hours, and every minute required enormous effort. Suddenly Slavka says: "Fuck all this, let's get out of here! To hell with it!" He began to go psychotic and was straining to get away. I jumped on him and began to hold him down. He was as strong as an ox. His and my lips had cracked badly, but the blood didn't even flow, it just solidified. I said: "Drink my water!" He looked at me with glassy eyes and snapped "Get away from me," and turned away. Very soon I began to go psychotic. I had used up my last bit of strength. I repeated his words, and I didn't use the nicest expressions either, and I too tried to get away. Slava held me down, dug out the hot sand from beneath me and then poured what was left of the water into his hand and wiped it on my face. It burned like boiling water. Only

someone who has gone mad with thirst can comprehend the depth of such self-sacrifice. After the experiment we became strong friends. He's a unique test pilot with exceptionally good health; there aren't any more like him. He's been through 30-g accelerations when body weight increases by a factor of 30.

[Zhdankin] An indiscrete question: how were you paid for such excruciating work?

[Davydov] Pretty poorly. For the "dehydration" experiment in the desert, for example, 60 kopecks an hour. Abroad, just one series of those kinds of experiments sets up the experimenter for the rest of his life.

[Zhdankin] Wasn't your wife against such risky work?

[Davydov] My Marina Lvovna didn't work at the Center, but at a civilian scientific scientific research institute; she's a specialist in optical mechanics, and therefore only limited reports of my adventures reached her. She understood that I loved my work, and she showed patience toward it. Whenever I'd return, I'd, naturally, underplay things and joke around. "Why are you all black and blue?" "Sticks," I'd say. "I'm so solid, see, even the thick ones broke." And in fact, I was hoisted up out of a tall forest. Usually, the helicopter hovers at treetop level, lowers a seat or hook (or a grapple), pulls it into the craft, and then ascends. And on this occasion, Alik Katok, a helicopter pilot of the greatest skill (he could set the front "foot" of the helicopter down on a five-kopeck coin), pulled me up above the treetops and revved the blades, and in an instant I was 300 meters up. By the time the winch pulled me up to the helicopter, there were only three unbroken strands left in the cable. The wife doesn't know about that.

[Zhdankin] And that probably wasn't your only "scrape."

[Davydov] One time, I was testing a diving suit, and I had to float for eight hours in the open sea. And suddenly my transmitter failed. I could hear them, but they couldn't hear me. My buddies, of course, rescued me, but I bathed in the icy waters of the Black Sea for 19 hours. I've described much of that in my three books, but there's still a lot that's waiting to be told.

[Zhdankin] What do you value most in people?

[Davydov] Friendliness, when a person is ready to be friends with everyone, to show sympathy for people. I am proud that I managed to "force through" as the first point in the tasks for training cosmonauts for actions under extreme conditions psychological training whose main emphasis was the development of that feeling. Intense stress can be endured only by an amicable person.

[Zhdankin] You said "force through." Was it difficult?

[Davydov] In general, the idea of a reliable rescue was realized with great difficulty. They almost accused me of slowing the pace of development of the Soviet space program. In the Kremlin I once heard: "You walked in here a lieutenant colonel, but you may walk out a private." At times, in fact, even their own cosmonauts, who by then were holding key posts, didn't understand. [passage omitted]

Questions Raised Regarding Decision on 'Salyut-7' Space Station

917Q0037A Moscow PRAVDA in Russian 27 Dec 90 Second Edition p 6

[Article by A. Tarasov, special correspondent of PRAVDA: "Time to Don Helmets?"]

[Text] As reported by A. Dunayev, chief of Glavkosmos [the main space agency] of the USSR, our famous "Salyut-7" has been heard from, and has moved into an uncontrolled descent. This is a forced acknowledgment, as the foreign press is already proclaiming it on the word of just as foreign space experts, while our specialists on public notification try, as usual, to remain silent.

Point-Blank Question

We were told by A. Dunayev that according to calculations, the orbital complex should enter the dense layers of the atmosphere and burn up in January or February. However, heat-resistant pieces of the station and of the "Cosmos-1686" vehicle might well reach the ground.

From the parameters of the orbit, Dunayev named regions between 51.6 deg. s. lat. and 51.6 deg. n. lat. as likely impact sites. I took a look at a map of the earth. People in the south could relax somewhat, as what is there is mainly ocean; the north is a comparatively continental band, highly populated in places. What would be the preference of a restless vehicle on the home stretch?

Dunayev said that prediction not be possible until two or three days prior to impact, as the descent is uncontrolled and depends only on braking by the atmosphere. He also gave assurances that the structure of the vehicle contained no harmful agents, and no one would be needing a gas mask.

During the briefing, in a somewhat different context, Dunayev mentioned a Texas law of criminal liability for deceiving the public. And for my part, I would add, it happens.

Years ago, one could hear talk in the halls of space-related enterprises that "Soyuz-7" was ailing when it was boosted to a higher orbit in 1986. It had already lost the capability to respond to commands. Had this been the optimum decision? The word was that the mission would last for several years, and then the satellite would be taken out of orbit by some powerful vehicle like the "Buran." But it is said that unexpected solar activity has caused heating and "swelling" of the atmosphere. Braking has occurred, just as unexpected and unforeseen.

Question: are peaks of solar activity really so unpredictable with consequences that are unknown to geophysicists? Who is supposed to calculate all options and correlate them with data of related sciences? Incidentally, PRAVDA also recently wrote about the need for improving solar forecasting, especially long-range.

"Buran" was late, so the sun hurried to make up for it.... It is naively believed that chance and damage can be avoided in outer space. No one is immune, either at the top or at the bottom. But to know what is happening and why, that is the right of everyone living under this sky. Are official sources working out a routine version? Do you know what they do to you for that in Texas? We just want straight answers.

Soviet, Japanese Approaches to Commercialization of Joint Space Flight

917Q0034 Moscow SOVETSKAYA ROSSIYA in Russian 28 Nov 90 First Edition p 2

[Article by M. Chernyshov: "Hard Currency From Space: On the Soviet-Japanese Space Flight"]

[Text] Is it possible to make money out of thin air? Out of space, for example? That's a naive question. Today everyone knows that it's possible to make some pretty good earnings on space. But is that in theory, or in practice?

In early December, the first Japanese cosmonaut will be sent into orbit. He will work alongside his Soviet colleagues for six days aboard the Mir orbital station. For Japan, one must think, this launch is an event. And the TBS firm, which paid for the space voyage of its television reporter, calculated everything in advance quite well: the costs and the probable revenues.

For more than a year, two staff members of the firm—the veteran Toyohiro Akiyama and young woman journalist Rioko Kikuchi—trained for the flight at Zvezdnyy Gorodok. The Japanese are learning from us the technical and other mysteries connected with manned voyages. It would not hurt us, it seems, to derive something from commercial approaches to the space program.

The Land of the Rising Sun embarked on the space path later than the other major powers. And its spending on space right now is much less than, say, that of the United States. But for all that, there's no way you could call the space plans of Japan and the things it has already achieved modest. The Japanese space program has to its credit the launching of several dozens of satellites for scientific and applied purposes. A powerful launch vehicle is being developed, and the development of an orbital module and its own shuttle are anticipated. And, finally, there are the intentions to organize at the beginning of the next century a manned lunar base for the extraction of helium, which could serve as a fuel for Earth-based thermonuclear reactors.

I mention all this so as to make it clear that Soviet-Japanese space cooperation has great prospects. On its own, Japan will be able to develop nowhere near everything that is needed for the implementation of the plans that have been outlined. Incidentally, the leasing of two manned flights—on Soviet hardware and the American shuttle—merely confirms that truth. For our specialists the first Soviet-Japanese flight, apart from all else, is also our first lesson in commerce.

The notion that the Soviet Union sets inordinately low prices—essentially, dumping prices—in the sale of its aerospace hardware, as well as in the leasing of its hardware, has been advanced more than once in the foreign press and the Soviet press. And now, in particular in one of the commentaries on Central Television, there has also surfaces a similar assertion that the Soviet side in this commercial deal sold too cheap....

That all depends on how you look at it, they say in USSR Glavkosmos: if the amount of the contract is converted into a ruble equivalent, the amount obtained is equal to the annual budget of some space enterprises or, say, the cost of an entire, rather large space program. During the preparations for the flight, our partners had requests for additional services. In many cases, we met them halfway. All of it was paid for separately, over and above the contract.

So how is it turning out: Do we have an exemplary deal and irreproachable fulfillment? Alas, we have never been able to extract the maximum gain even in obvious situations. Now, too, it is possible to lodge complaints of a lack of thoroughness and initiative against not only Glavkosmos, but also other Soviet organizations that are participating in this commercial undertaking. The production of, say, souvenirs or of consumer items with the logo of the flight has not been properly organized.

For one and a half years now, TBS has been airing television stories on the coming flight. Taking advantage of the interest displayed toward them by the public, the television company inserts in those stories the advertising of various Japanese firms. TBS is doing business, trying to recover the expenses. But after all, the television stories also promote the Soviet space program at the same time. If we, Glavkosmos believes, took it into our heads to advertize our own hardware by convention means, we would have to pay enormous amounts of money. Even a minute of advertising time on Japanese television is very, very expensive. But according to existing information, TBS's television stories about the joint flight have already taken up about 10 hours.

Any commercial deal is always a game with its own rules. One probably shouldn't expect the participants in the game to be ready to show all their cards at any given moment. At the stage in which the contract was concluded, the representatives of TBS were optimistic and stated that they intended to derive a profit from the deal of approximately ¥5 billion. Now the optimistic statements are fewer, and one can even hear complaints that

the financial receipts are much less than anticipated. In short, if one assumes that we sold too cheap, it would also seem that the Japanese themselves didn't win, either. Is that not so?

From the start, the TBS firm did not hide the fact that in this deal money was not its main goal. Its objective was to set itself off among other, similar television companies as the first and thus far the only private firm with its own cosmonaut. And for what? For the sake of vanity? Not at all. Until recently, it was mainly the intelligentsia and middle-aged and elderly people who watched this, the television channel that was fated to become the "space" channel. But what television company does not dream of expanding its audience and, particularly, of attracting young people? Japanese boys and girls are quite familiar with the space program. Motion pictures, comic books, books and space toys are promoting this acquaintance. Parks are being created in which one can sit in a real spacecraft simulator and "fly off into space" in what's almost a real spacecraft. They have everything. Except a living symbol, their own, if you will, Gagarin. Now teenagers will have such a symbol, and TBS will gain young television viewers.

The approach of the Japanese to the approval of the candidate for the flight, it seems, also testifies that for them business and commercial considerations come before purely ostentatious considerations. For the two people training for the launch, the final choice in favor of one or the other is a most serious psychological test. The two move at the same time toward the same goal. Both seem to have similar results. But then.... In our case, 48-year-old Toyohiro Akiyama and 26-year-old Rioko Kikuchi met. They diplomatically explained the choice in favor of Akiyama as influenced by Japanese tradition, according to which the man does not give way to the woman, but goes first, taking upon himself all the dangers of the road. But I am certain that the fact that Akiyama had 20 years of experience in television journalism was not a minor consideration. And no matter how attractive youth is in itself, preference was given essentially to the most important thing for this situation—dependable professionalism.

Working with Akiyama will be an enormous ground team—more than 100 television personnel. Where on earth would such a heap of video information be going? The explanation is quite simple: the filmed stories will be stuffed with advertising, and everything in one way or another will be put to use. On the whole, all the commercial matters are being thought out and specified down to the slightest details. Reader, if you watch the launch of the rocket on television, direct your attention to the advertising inscriptions—the names of major Japanese firms—that will decorate the launch vehicle. TBS will receive money for all that, but only if there's no fog that day. If it happens that a shroud conceals the launch vehicle, then that profitable item won't exist for TBS.

Against the backdrop of such Japanese efficiency and good organization, it's not, in general, that difficult to tear Glavkosmos, as they say, to pieces—if only in connection with our attitude toward that advertising. For to this day, among many highly placed space managers there is the deep conviction that Soviet space hardware does not need advertising. "Everyone already knows about us" is the kind of cliche I had occasion to hear in more than one office. But only in the company of foreign partners does it become clear that they don't know anywhere near everything about the capabilities of Soviet industry. For example, the desire of our specialists to deal in large systems—rockets, satellites—is great. But one can't help but notice that the West is not all welcoming with open arms, say, Soviet launch vehicles to the market. And that means that we have to be persistent about seeking buyers of certain individual components of aerospace hardware and of everything that our space industry is rich in.

And another thing: enough of this rush to reorganize everything. Glavkosmos was established five years ago. Now that enterprises have gotten the right to enter the market independently, the tendency is to regard Glavkosmos as some bureaucratic structure and to eliminate it. And after that? After that, every enterprise will seek its own specialists in advertising, trade, and so forth. Is it worth completing the circle? Are there, perhaps, more rational solutions? Like, maybe, using the marketing experience that has been gained by Glavkosmos?

As for the Soviet-Japanese flight, I am convinced that neither we nor our partners sold too cheap. Earning hard currency is difficult everywhere, including in space. And in general we are odd people: it was just yesterday that we intrepidly brought partners into collaboration "on a gratis basis," that is, free of charge, and no one said anything. Today we have begun to earn money, and all of a sudden people are discontented and a fuss is being made that "It is not enough!"..

NPO Energiya Raised Contract Price for Japanese Space Flight

917Q0035 Moscow RABOCHAYA TRIBUNA in Russian 18 Dec 90 p 3

[Article by IAN correspondent A. Bogatyrev for RABOCHAYA TRIBUNA (Tokyo): "Japanese Comments on the Space Flight of the TBS Journalist"; first paragraph is RABOCHAYA TRIBUNA introduction]

[Text] **In early December, all of Japan kept careful watch on the television screens, on which events taking place far beyond it were developing. The TBS television corporation made broadcasts directly from Baykonur, and the Japanese were able for the first time to watch all the machinations associated with the implementation of a space program.**

Yes, for the first time, professional journalist Toyohiro Akiyama found himself away from Earth. It is a little annoying that it was not a Soviet representative who

took off, but we hope that the considerations that guided the organizers of the flight will play a positive role in the improvement of the quite complex Soviet-Japanese relations.

We have become accustomed to our compatriots working in space. But for Japan, this was its first flight. That's why the newspapers and television devoted so much attention to it. However, when you see the reaction of the Japanese press to the process involving the preparation for the space program, you sometimes get a faint, if not too pleasant, feeling in your heart.

After T. Akiyama went aloft in space, representatives of TBS held a press conference at which they spoke about the negotiations with the Soviet side, about the preparation for the flight, and so on. The financial side of the matter aroused particular interest.

The newspaper TOKYO SHIMBUN, for example, on 4 December wrote: "As a TBS representative reported, the Japanese television corporation was required to put out more than ¥5 billion for its space program, and half of that amount was paid to the Soviet Union. According to the contract that was signed with Glavkosmos, some ¥1.3 billion were to be given over to the Soviet side. But later, the demands that the amount be increased became increasingly persistent, and there was nothing left for the Japanese to do. The USSR has in fact struck a blow to the spirit of commerce that reaches the point of absurdity."

So just what is it, primarily, that does not suit the Japanese in our approach to commerce? Could it be that the cost of a flight into space is inordinately high for them? "No," H. Kuroda answers me, "it has nothing to do with the price. TBS has a budget, and the company, of course, plans its capabilities in advance. When discussing the terms with Glavkosmos, we arrived at the amount that was subsequently set down in the contract. But beforehand, in the corporation, during the debates—which were, of course, not without disputes—we came to the conclusion that we could allocate those assets for the organization of the flight. After all, for us this is an advertising measure, and we were basing it on our capabilities, as well as on the figures turned over to us by Glavkosmos. However, somewhere half-way through the implementation of the program, Glavkosmos withdrew from the matter, and supervision passed into the hands of the Energiya Association. And that's where we found out just what the principle of a full cost-accounting budget is and what the right of Soviet enterprises to earn foreign currency means. The Energiya Association wasn't the least bit concerned about the terms of the contract, and often it actions were guided only its desire to earn foreign currency by any means possible and a little more quickly and, in our opinion, without regard for its own long-term interests. In short, our corporation encountered the other side of the coin of perestroyka. We saw that the USSR is adopting from capitalism what are by no means its best features, features that are typical of its early period."

In fact, the matter is obviously not money. Participation in a Soviet flight, according to Japanese figures, is no less than one-fifth as expensive as the flight of a Japanese astronaut on the American space shuttle in the NASA program. It's not good business to enter trade with figures that have been reached merely by eye; but once the contract has been concluded, it is probably necessary to do all one can to save face.

U.S. Commission Recommendation on Phaseout of Space Shuttle Reported

917Q0038A Moscow PRAVDA in Russian 25 Dec 90 Second Edition p 5

[Article by V. Sukhoy: "End of Shuttles?"]

[Text] New York, 24 Dec (PRAVDA correspondent)—The future of U.S. space shuttles has been called in question. A special White House Commission headed by Norman Augustine, president of Martin-Mariette Aerospace Corporation, has issued a statement recommending that missions of returnable spacecraft of the shuttle type should no longer be stressed.

In the Commissions' opinion, the new shuttle Endeavor that will come off the production line of the Palmdale California plant next April to replace the Challenger, which exploded on launch, should be the last shuttle in NASA's fleet.

What guided the Commission, eliciting such a recommendation that closes the sky to shuttle missions? The main reason is research data showing that disasters like the tragic loss of Challenger in January 1986 are sadly inevitable. The "risk factor" is one accident in 35 missions.

And although NASA has its own views, one in 100,000, most members of the Commission are inclined to believe that the next disaster may occur even at the end of this century. The conclusions of the Commission state that "Manned missions on returnable vehicles must be replaced by unmanned expeditions of space rockets capable of putting payloads into orbit."

And what about NASA's plans? After all, the administration had intended to build in space a permanently manned station by 1999 at an estimated cost of 35 billion dollars. To "rig" the space station, NASA was assuming a minimum of 30 shuttle missions. And what is to be done with the pride of the administration, the giant Hubble Space Telescope that cost 1.5 billion dollars to put into orbit? Indeed, what is to be done with the returnable shuttles themselves?

Jerry Gray, a member of the White House Commission and representative of the American Institute of Aeronautics and Astronautics, believes that engines and other shuttle components should be used to build reliable transport vehicles. According to his calculations, the

accident rate of "space trucks" is much lower: a maximum of one explosion in 100 flights. But no people will be destroyed, only cargo and hopes.

NASA representative Mark Hess reacted comparatively calmly to the Commission's recommendations: "We will be only too glad to see the United States develop powerful unmanned vehicles. But for now, at least for the foreseeable future, our manned shuttles are destined to play a key role...." Hess emphasized that Atlantis, Discovery and Columbia had long ago been transformed to a metaphor of the American spirit. He cited Ronald Reagan's statement in April 1981: "The space shuttle is more than just a show of our technological prowess. It has expanded the horizons of our dream."

Issue of Monopoly of Space Research by IKI Reargued

917Q0042A Moscow IZVESTIYA in Russian 11 Jan 91 Union Edition p 3

[Article by S. Leskov: "Monopoly on a Comet, or the Space Program in the Era of Glasnost"; first two paragraphs are source introduction; they are followed by a letter to the editor]

[Text] **Recently, space science has been the target of quite a few critical comments on the pages of various publications, including IZVESTIYA, and they have a great deal in common with one another. And it is neither a passing fancy nor a desire to kick a fallen idol a bit harder after singing long laudatory hymns to it. In IZVESTIYA (No 143, 1990), in particular, Professor I. Podgornyy, recipient of the Lenin Prize, shared his own thoughts about the problems of the USSR Academy of Sciences' IKI [Space Research Institute]. In the opinion of that scholar, the unhealthy atmosphere in the head academic institution has been one of the major hindrances to the successful realization of the large space projects of recent years.**

These thoughts are shared by many scientists—which has been confirmed by the mail received by the editorial staff after I. Podgornyy's article. But sharp disagreement with that position has been expressed in some letters.

I. Podgornyy's article is slanderous in that the overwhelming majority of facts cited in it do not correspond to reality. We will demonstrate that with a few examples.

It is not true that "prominent Soviet cometary scientists" did not participate in the discussion of the VEGA Project. Almost all of the most important comet specialists (foreign and domestic) participated in its discussion. It is not true that the former director of the Space Research Institute, Academician R. Sagdeyev, decided "to manufacture practically all the equipment abroad." In fact, the cost of the on-board instruments developed and manufactured in the USSR amounted to 40 million rubles (i.e., half the cost of all the project's scientific instruments). It is not true that the suggestions of Soviet scientists were rejected without discussion, since all the comet experiments of the Soviet scientists (except for one) were approved after careful consideration by the international commission. At a number of international congresses, the project's results were rated highly, and I. Podgornyy has no grounds to run them down. On the other hand, he pushes as unique the modest results of one of the two dozen satellites of the Intercosmos series (Intercosmos-Bulgaria-1300) in which he was personally involved. It is not true that the deputy director of the IKI, USSR State Prize Recipient V. Balebanov, gave the order to turn off this "still operating" satellite; the order was not given by him and was associated with a malfunction of the satellite.

With regard to A. Galevev, a corresponding member of the USSR Academy of Sciences who was elected director of the IKI from among others by a substantial majority of the IKI's scientific associates and who is one of our physicists most cited abroad, it was said that he has made a scientific career...out of social work.

We believe that apologies should be made to the IKI's collective, the activities of which have been presented in a distorted form, as well as to R. Sagdeyev, A. Galevev and V. Balebanov, whose honor and dignity have been impugned.

[Signed] *Respectfully, Associates of the IKI: K. Gringauz, recipient of the Lenin and USSR State Prizes, V. Linkin, recipient of the Lenin Prize, V. Moroz, recipient of the USSR State Prize, and A. Mukhin, recipient of the USSR State Prize.*

What is there to say about the letter? First of all, some of the objections pertain to the field of scientific investigations. And the newspaper pages are hardly a suitable place for that kind of dispute. The very appeal to the newspaper is indicative of the fact that the possibilities for scientific discussion between proponents of differing points of view within the IKI itself are, apparently, slim.

The letter touches upon the Intercosmos-Bulgaria-1300 project, the reference to which was only an isolated incident. The corrections presented entail new questions. Yes, the satellite was turned off on an order from the military, but no general would have dared such willfulness arbitrarily. In this instance, the military people were guided by the opinion of the institute's deputy director, V. Balebanov. In point of fact, is it acceptable that, in the absence of the scientist who had actually overseen the scientific program, an order is given to turn off an expensive craft?

Now about the main thing—the claims which pertain to one of the most famous space projects of recent times, the mission to Halley's Comet. It is indeed a vital question for the development of the space program: the state of scientific instrument making determines to a great extent the potential of the sector and its prospects. But why, then, despite what was said on this matter in the letter from the IKI's associates, is the conviction firmly held in scientific circles that, in recent interplanetary missions, we have assumed the role of an unpaid carrier for foreign equipment, by far not of the best

quality, while our own instrument making industry has been given the red light? It is foolish to come out against scientific cooperation in such an expensive undertaking as the space program. And it can only be hailed that, during VEGA and Fobos, the Soviet space program had finally begun to lift the veil of secrecy. But was the benefit from the open door policy equally mutual? Something was not being said if, after the international projects, our instrument building industry made great advances. In the scientific reports, as is well known, we never had any shortcomings....

An old document was dug up for me in the institute's planning department. Yes, based on this, it appears that, even inside the country, the IKI had quite a few partners. But what does a careful study of the list show? With rare exception, acting as the IKI's partners were industrial enterprises and sectorial scientific research institutes which could be used by the "white-collar people" of the main institution for technical purposes only, for manufacturing the instruments. The opportunity for independent research work and for reviewing its own ideas was granted only to IZMIRAN [the USSR Academy of Sciences' Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation Institute], where there is, perhaps, the only scientific orientation "unstaked" to IKI; the opportunity was also granted to GEOKhI AN SSSR [the USSR Academy of Sciences' Geochemistry and Analytical Chemistry Institute], not in the comet part of the project, but rather in the less prestigious Venusian part.

But, perhaps, there was not even anything to discuss. And what about the Soviet mass spectrometer, over which, despite the apprehension of the scientists, the project supervisors preferred the West German ING mass spectrometer? The reason was not that, somewhat earlier, because of the low quality, it was refused a place on the European Giotto craft—it later failed even on the VEGA vehicles. Many other Western instruments also failed, lowering the scientific potential of the VEGA vehicles quite a bit. And the fact that our instruments could, if given the chance, work flawlessly has been confirmed by the dust particle counters developed in Leningrad, which experienced no problems during the flight.

During the preparation of this article, in checking and rechecking the numerous facts, we talked with representatives of many space-related enterprises and organizations. Almost all of them, including academicians and space industry executives, are of the same mind: the IKI carefully guards its monopoly in space science. Being the head developer of the majority of projects, it does not allow competitors to come even close to organizing independent research. At best, they are on backup status, under the aegis of the IKI. A convincing, albeit sad, illustration of the state of affairs is the issue of the international journal NATURE, in which the first VEGA results were published. I did a little statistical study. More than 70 signatures under the articles belong to associates of the Space Research Institute, and, for the rest of the USSR, I managed to scrape up only 20 names. And three-fourths of that meager number belong to IZMIRAN and the Leningrad Fiztekh [Ioffe Physical Technical Institute]. Where, then, is the interaction of the "prominent Soviet comet scientists"? Where is all the rest of our domestic science—the experiment, after all, was pronounced a "Soviet" one? Incidentally, in that same issue of NATURE, it is easy to discern that Western participants in the project who do not even claim, as we do, the title of a "space power" were represented by a large number of scientific centers and laboratories that worked on an equal footing.

The authors of the "rebuttal" also pass over in silence other key points of our article, namely the failure of the Fobos mission and the misfortune with the Aktivnyy satellite. After all, those projects were publicized with such enviable enterprise, so why should we now not say something about the causes of the failures which have become so chronic? Perhaps it is because, in a monopoly, when you are not being pressed by an ambitious competitor, it does not matter how many times you mess up—even if you land in Mariupol instead of on Mars. It is all the same—there are no candidates visible on the horizon, they have died off.

Let us assume that industry is at fault in the double mishap with the Fobos vehicles. But would it not be a comforting self-delusion to write off all of science's sins? In such large projects, the collectives of scientists and designers are the communicating vessels.

No matter how much we puff our cheeks, it is hard to see how it will increase the prestige of our science in the world space market. A couple of months ago, the flight of the international probe Ulysses began; it is to carry out the largest international project on studying Jupiter and the Sun. Among the names on the list of 150 scientific consultants, equipment developers, and specialists in the management and analysis of data you will not find any Soviet participants. And yet, after the so exalted cooperation on VEGA and Fobos, we had a right to count on a reciprocal invitation. No, we are not taken in as partners. Perhaps the foreigners do not want to take chances with their own program? Yet, at home, it is easy to swagger, and, indeed, the monopoly is also expanding to information from abroad.

But a threat hangs over the scientific monopolies. A terrible threat. And it is summed up in one word: money. Because of the specific nature of space research, it needs more money, much more money, than do other sciences. And each critical article is perceived by the scientists awaiting appropriations from the treasury as an encroachment upon the material well-being of the entire sector. No one is playing the hypocrite in the IKI: the danger of the newspaper criticism lies in the fact that, even without it, parliamentarians irritated at the space program under the conditions of the economic crisis will reduce the appropriations for the sector. It goes without saying that in such arguments, cause and effect are changing places. The newspapers are in now way provoking the increase in irritation at the space-related

sectors of science and industry—it is their own flaws and their inability to prove to society the necessity of the large investments in this field.

By the way, there is nothing wrong with having to justify expenditures—we are not living in the lap of luxury now. Frankly speaking, I see nothing shameful in the fact that our parliament's deputies, even if they are not well versed in physics, are inquiring about how efficiently the money society is allocating for space science is being spent. No matter how much the specialists complain, the funds are considerable—hundreds of millions are going for basic research, and billions for industry. But, for all of science, the most important questions have been decided within a narrow circle of trusted IKI specialists. The USSR Academy of Sciences' Interbranch Scientific Technical Council, so authoritative in the time of M. Keldysh, has been transformed today into an ornamental body. Returning to that same VEGA, can it be said with certainty that the project justified the advance monies? Why do so many prominent specialists, no matter how much they praise their own work in the IKI itself, look with skepticism at the scientific achievements of an outwardly effective mission? For example, in the voluminous monograph by the well-known comet scientist, L. Shulman, whose lofty authority is unquestionable even within the IKI itself, it was stated that the experiments on the VEGA craft did not add anything new to the understanding of the nature of comets. Incidentally, after that monograph came out, the scientist was awarded the USSR Academy of Sciences' Bredikhin Prize for outstanding results in cometary astrophysics.

These days, it is being said more and more frequently that the situation in our space program will be rescued by the establishment of a single coordinating body like the American NASA. An alluring proposal, but we will not, as frequently happens, lapse into euphoria over the administrative innovations. With regard to science, our Soviet NASA will justify its own functions only when the Academy of Sciences manages to place all the scientific institutions on an equal footing and stops giving individual institutes the sole right to call the tune in their own fields. It is doubtful that this will come about any time soon. As Academician V. Zuyev said in an address before the USSR Supreme Soviet, morally sound forces mudy be found within the academy for that. For now, grounds for hope are shaky.

Program Notes Role of Satellite in Arms Control Monitoring

PM1502170991 Moscow Central Television First Program Network in Russian 0330 GMT 14 Feb 91

[From the "Utro 120 + 30" program: Report by A. Gerasimov]

[Text][Gerasimov] In recent years in our country, ravaged by economic and domestic policy problems, space research has, putting it mildly, become a dirty word. In view of the empty stores and lack of confidence in the future, the mere mention of space research causes irritation to some people. However, in the heat of the space nihilism, one aspect of the space program, and probably one of the most important aspects, is being forgotten. I am referring to national and international security. If, at the philistine level, the Soviet space program provokes dissatisfaction because of the absence of immediate returns, it should be remembered that international stability is the most immediate return gained from space research.

[V. Smolin, first deputy chief of the USSR Foreign Ministry Evaluation and Planning Administration] First, compliance with most of the agreements that have been concluded in the arms control sphere is monitored from space. Second, observation from space can be a very important confidence-building measure providing reassurance that there will be no surprise attack. And third, knowledge of partners is very important in ridding states of excessive fear.

The events in the Persian Gulf are being observed from space, and being observed very closely, and the information gathered in this way is very important to the overall evaluation of the situation. This is certainly important for the countries directly involved in the conflict, but in my opinion it is also very important for the entire international community. The point is that this military conflict is probably the first in which a deliberate attempt has been made to influence the ecological situation. A global threat has arisen. And it is of great importance to the entire international community to know the scale of this catastrophe and to mobilize forces to prevent its further expansion.

[Gerasimov] A simple job in orbit—the filming by television camera of the area of combat operations has already enabled the whole world to appreciate the scale of the catastrophe in the Persian Gulf.

Incidentally, our country is the only one among the space powers capable of regularly obtaining video information from space.

Academician Denies Topaz Reactor SDI Role

91WC0068A Moscow IZVESTIYA in Russian 23 Feb 91 Union Edition p 6

[Report by S. Leskov on comments by Academician N. Ponomarev-Stepnoy: "The Soviet Reactor: Not To Be Used for SDI!"]

[Text] **A number of news agencies have reported the sensational news that the U.S. Administration intends to acquire from the USSR a space nuclear installation to use in work on its SDI program. Doubt was cast on this information by IZVESTIYA No. 8 of this year. On the return from the United States of a Soviet delegation led by Academician N. Ponomarev-Stepnoy, he explained to our IZVESTIYA correspondent what specifically occurred during the talks with the American side.**

Academician N. Ponomarev-Stepnoy, first deputy director of the Institute of Atomic Energy imeni Kurchatov, assured us that in the talks on the sale of a Topaz-2 nuclear power installation the Soviet side set two indispensable conditions. First, "know-how" in the design should not be violated and the reactor could not be dismantled. Second, the U.S. partners should provide firm guarantees that the device would not be used for military purposes.

Information linking SDI and the Soviet Topaz-2 reactor leaked to the Western press was immediately disavowed by U.S. experts who took part in the talks. J. Vetch, the president of the Space Power Company which is holding the talks with the USSR, made an official statement to the journal SPACE NEWS. Unfortunately, the rumors were not stopped. During the last visit a similar statement was made to the journal MILITARY NEWS by Academician N. Ponomarev-Stepnoy. It is the opinion of the Soviet scientist that the misunderstanding about the possible use of the Topaz-2 in the SDI program could have resulted from the fact that throughout the world there are organizations working in space research that are in one way or another connected with the military-industrial complex. In this case, however, there is no justification for doubting the control measures that have been planned. It is a question only of the possible use of the Topaz-2 after its ground tests for a communications satellite. Moreover, at this time there is no question of the delivery of nuclear fuel from the USSR to operate the Topaz-2 in orbit.

With respect to the initial information indicating that the Americans have been showing great interest in the Soviet reactor, it is fully in accord with the reality. As N. Ponomarev-Stepnoy said, he has never in his life seen Soviet equipment attract so much attention. Academician R. Sagdeyev, who is presently living in the United States and who initially spoke out vigorously against the injection of nuclear reactors into orbit, changed his position when he had familiarized himself with the safety guarantees of the Topaz-2, and supported the sale of the Soviet installation for joint research offering the two sides great promise. The sensation about the Topaz-2 is explained by the fact that the United States stopped working in this direction and, according to its own assessments, made it possible for the USSR to get 10 years ahead.

All of this is a cunning move to flatter that self-esteem that of late has too often been wounded here. If the contract now being worked on (worth approximately $10 million) to acquire a Topaz-2 is concluded, then the money received could be used to continue research in this field, which is a priority for us. For in 1991 no funding has been allocated for work on a space-based thermal emission converter. One of the developers of the device that caused the sensation in the West is, within the framework of conversion, being switched to the production of packaging for dairy products. But you will not be seeing that in America....

Plans For Large Communications Satellites Said To Be Flawed

917Q0058 Moscow KOMSOMOLSKAYA PRAVDA in Russian 15 Feb 91 p 2

[Article by correspondent V. Nelyubin: "King of Satellites; Another 'Project of the Century'"]

[Text] Krasnoyarsk—**Once upon a time Khodzha Nasreddin proposed to the shah that for 100 sacks of gold he could teach a donkey to talk in 20 years. The shah agreed, but laid down the condition that if he failed, the wanderer would lose his head. Nasreddin's friends started to bid him their final farewells early, and his enemies rejoiced. Only the teacher of literature remained calm. His reasoning was simple: In 20 years either the shah would have died, or the donkey would have died, or he himself would have died.... (An old story)**

One fine day we were pleased to hear the news about a "new success for Soviet science and technology"—the launching of "the world's most powerful" launch vehicle, the Energiya. This space heavyweight had "heaved" 100 tons into orbit around the Earth. One man exclaimed enthusiastically "Well, at least we have got the better of the Americans in space!" I was that person. With the artless simplicity of all the Soviet people I did not suspect that the American Saturn-5 launch vehicle had lofted 139 tons(!) way back in the late 1960's.

The fanfares rang out, and the those who had developed the Energiya face a question: What can we do with this space "heavyweight?" This monster had not been cheap. According to the most conservative calculations it had run to 14 billion rubles [R]. This launch vehicle could not now be left with nothing to do! Extensive advertising began for the idea of a "king of satellites"—an 18-ton platform "stuffed" with electronics, a super space telephone exchange for 1.5 million telephone channels, and not a word was said about the fact that the "project of the century" together with the ground stations servicing the "king of satellites" would cost the state budget R50-60 billion.

Today, all the country's enterprises are busy manufacturing equipment for various kinds of communications satellites, and about two tons of this kind of equipment is being launched each year. Three or four times as much equipment is required for one 18-ton platform. And the authors of the "project of the century" are talking about launching three to six of them.

Everyone is aware of the quality of Soviet electronics. For this reason the rare Soviet satellite stays in orbit for five or six years, coming to the end of its useful life sooner by a factor of 1.5 to two than its foreign counterpart. But whereas an ordinary satellite (weighing, incidentally, about two tons) that has reached the end of its useful life can be replaced relatively easily in orbit with another, each launch of an 18-ton platform is incredibly expensive.

So here comes 1993 (it is in that year that the authors of the superproject plan to launch the first "king of satellites" into orbit), and the public is ecstatic. The only trouble is that they have not managed to build the ground stations that ensure the reception and transmission of telephone conversations via the satellite, and have forgotten to build the many thousands of ordinary telephone exchanges and the millions of telephones in apartments. And that means that the "king of satellites" must carry on in space until back on Earth the entire infrastructure has been developed in order to use its splendid facilities. And it will be necessary to wait for oh such a long time!

Judge for yourselves. The cost of making a single ordinary set of equipment for one subscriber in an average city is R400, and in the countryside it is 2.5 times more. In a satellite system, apart from the ordinary telephone equipment, a subscriber must have an individual or collective transceiver with a parabolic antenna, at a cost of more than R80,000. And we are talking about many millions of subscribers in the space telephone system.

And that is without even mentioning the "minor matters," such as the fact that the parameters of the "king of satellites" are not in compliance with the standards laid down by the International Electronic Communications Union [Mezhdunarodnyy Soyuz Elektrosvyazi], of which our country is an official member, and that the world trend in space equipment design is totally ignored. The Soviets have their pride! Nevertheless, foreign experts abandoned long ago the idea of developing a monster satellite. All bets have been laid on increasing the carrying capacity (up to 120,000 telephone channels) on communications satellites already developed by improving the onboard equipment.

In May 1989 the "project of the century" was discussed at a session of the USSR Council of Ministers. At that time, for the first time in the history of our space sector it was decided to hold a competition for plans for a promising communications system. A state expert commission led by Academician Yu.V. Gulyayev was set up under the USSR State Planning Committee. It was planned to announce the results last year, but the dots have still not been placed over the "i's."

The Energiya Scientific Production Association, a firm engaged in the development of manned space vehicles, offered one plan. The Energiya and the Buran were developed there, and the "king of satellites" project. Another plan was proposed by the Scientific Production Association for Applied Mechanics, led by Academician M.F. Reshetnev, which has developed virtually all Soviet communications, navigation, and geodetic satellites.

...The final "bell" was sounded recently when the Salyut-7 station started to fall back to Earth. And although according to the official version it was caused by a burst of solar activity, the experts know what led to this result and the launch of a new orbital station, the Mir station, in 1986; the Soviet space people reported to the latest high forum. There were no facilities for simultaneous operation of two such large objects, and Salyut-7 was sent to the higher layers of the atmosphere for mothballing. Even then the experts were predicting that by using the fuel remaining on the station it could have been landed on Earth, promising that otherwise Salyut-7 would make an uncontrolled reentry early in 1991. They brushed this aside like a troublesome fly. But as we see, in space a scientific calculation is much more effective than acute political flair. But is this true only for space?

Ministry of Defense Space Units' Party Conference Held

PM0703110591 Moscow KRASNAYA ZVEZDA in Russian 1 Mar 91 First Edition p 3

[Correspondent Lieutenant Colonel V. Zyubin report: "Unity of Aim and Discipline"]

[Text] The Second Party Conference of the USSR Ministry of Defense Space Units has been held. Lieutenant General I. Kurinnyy, chief of the USSR Ministry of Defense Space Units Political Directorate, gave a report on the renewal of party work and the action program for space unit Communists at the current stage.

The following addressed the party conference: A. Soshnikov, senior official on the USSR President's apparatus; Colonel General V. Ivanov, chief of the USSR Ministry of Defense Space Units; Colonel V. Solovyev, Lieutenant Colonel V. Zarubin, and Major A. Kireyev.

The party committee and delegates to the all-Army party conference were elected.

'Koskon' Communications Satellite Venture

LD2802232791

[Editorial report] Moscow Central Television First Program Network in Russian, in its "Vremya" newscast at 1800 GMT on 28 February, carries a three-minute report by correspondent P. Orlov on the joint venture to modernize Soviet communication systems using the space and defense technology within the framework of conversion. The estimates show that at least 60 billion rubles are needed to bring the present outmoded and inefficient system up to the international level, but this figure will be 10 times lower if space technology is be used. The founders of the international innovation enterprise Koskon (Space Conversion) have already raised the necessary capital.

A.I. Ilyin, the project's chief constructor, says in an interview that the international innovation joint venture Koskom sees as its main task the creation of the global low-orbit satellite communications system for solving the information technology problems in various branches of the national economy."

K.I. Pobedonostsev, director of the experimental constructive bureau of the Moscow Energy Institute, says when interviewed: "We also hope to create the cheapest

but most effective information system for education and other areas of social activity in our country, successfully and in the shortest possible time."

According to A.I. Dunayev, chief of the Glavkosmos: "If we are able to have a sufficiently cheap apparatus and the proper communications, the satellite itself and the rocket carrier will be a minimal expenditure, even in comparison with the existing expenditures."

V.I. Khokhlov, USSR deputy communications minister, says in an interview: "Today we can realistically speak about the competitive systems. And in this regard the Koskon system is remarkable—first of all because we see it as a system complementing the existing systems as well as the proposed systems we have, and we attach an important role to it."

In conclusion, correspondent Orlov says that if everything runs smoothly, people could be using the satellite telephone system within three years.

Comments on 'Koskon' Group's Planned Satellite Communications System

PM0603134591 Moscow Central Television First Program Network in Russian 1800 GMT 28 Feb 91

[Report by P. Orlov on new communication technology project "Koskon", place and date not given; from the "Vremya" newscast]

[Text] [Orlov] The communications system is one of the first sectors where the possibilities of the military-industrial complex can be exploited exclusively for civilian purposes. It is as though the telephone lines crisscrossing the globe were cut at our borders. There is no need to describe the communications situation in our country. Sixty billion [units not given] are needed just to reach normal world standards, or tens of times less if space technology is used. These funds were raised by the founders of "Koskon", a newly created international innovation enterprise, by "clubbing together" as people might say.

[A.I. Ilin, chief designer of the project] The international joint innovation enterprise "Koskon"—in other words, "Space Conversion"—sets as its main task the creation of a global low-orbit satellite communications system to resolve information technology tasks in various sectors of the economy.

[K.I. Pobedonostsev, director of the Moscow Energy Institute Experimental Design Bureau] We also hope to create, successfully and in the shortest possible time, the cheapest, most effective information technology system for our country's education system and other areas of our social activity.

[Orlov] This is how the authors of the project picture it. Thirty-two satellites like this one [video shows diagram of satellite] are needed so that it will be possible with a handset this small to connect directly via satellite with another telephone anywhere in the country or in the world.

The first test launch was carried out on 29 January 1991. The speed of the operation is easy to explain: The main elements of this system are taken from military research and development work. There is also a prototype control system near Moscow, at the Flight Control Center, and at Medvezhye Ozera.

This is the view of those responsible for the manufacture of the rocket-satellite system.

[A.I. Dunayev, head of USSR Main Administration for the Creation and Utilization of Space Technology (Glavkosmos)] In any case, provided that the subscriber equipment that was shown here can be made sufficiently cheaply, the cost of the satellite itself and of the rocket of this type will naturally be minimal even compared with existing costs.

[Orlov] The consumers—that is, those who know our economy best—are viewing this with optimism, albeit cautious optimism.

[V.I. Khokhlov, USSR Deputy Communications Minister] We can now realistically speak of competitive systems. In this respect the "Koskon" system is noteworthy for the following reason: First, we see it as a system that complements existing systems and also as a system that complements our future systems. We are giving it quite an important and substantial role.

[Orlov] However, the ups and downs of economic life in our country can wreck any good initiative. In the case of "Koskon" this is countered by the common sense of real economics—achieving something through joint efforts. And if this is successful, we will be able to use satellite telephones in three years from now.

Aerospace Research Assistance Offered Abroad

HK1503030391 Moscow in Tagalog to the Philippines 1300 GMT 14 Mar 91

[Text] The Soviet Union is prepared to assist foreign aviation companies design space shuttles and commercial aircraft. This was declared by Aleksandr Geroshenko, deputy minister of the Soviet aviation industry, to newsmen in Manila during the International Air Show being held in Villamor Airbase. According to Geroshenko, the Soviet Union was among the first to engage in aerospace research, for which capital, in the experience of other countries, is often lacking.

Geroshenko said that the 20 countries joining in the present air show have decided to set up an international group that will coordinate aerospace research.

Gorbachev To Chair Space Commission on 1992 International Space Year

LD0502231191 Moscow TASS International Service in Russian 1845 GMT 5 Feb 91

[Text] Moscow, 5 Feb (TASS)—The UN General Assembly has proclaimed 1992 International Space Year, and on 12 April 1991 it will be the 30th anniversary of man's first flight into space. As reported here today, a commission chaired by USSR President Mikhail Gorbachev was formed to prepare and conduct work in this regard.

The commission includes Nursultan Nazarbayev, president of the Kazakh Soviet Socialist Republic, the territory from which Yuriy Gagarin, the world's first cosmonaut, set out, and the heads of a number of ministries and departments.

The USSR Cabinet of Ministers has been charged with submitting the relevant proposals to the commission.

French-Soviet Space Agreement Signed

LD0802105391 Moscow TASS International Service in Russian 0122 GMT 8 Feb 91

[By TASS correspondent Igor Kuleshov]

[Excerpt] Paris, 8 Feb (TASS)—The use of space means for exploring natural resources, the environment, atomic power engineering, health care, pharmacology, and telecommunications are the basic areas of Soviet-French scientific and technical cooperation for the future.

The principles and specific forms of interaction between the sides are registered in a protocol of cooperation between the USSR State Committee for Science and Technology and the French Ministry of Research and Technology and in a program of measures for its implementation for 1991. They were signed by USSR Deputy Prime Minister N.P. Laverov, chairman of the State Committee for Science and Technology, and Hubert Curien, French minister of research and technology. [passage omitted]

No 'Barriers' To Joint U.S.- Soviet Space Flights

PM1903154591 Moscow IZVESTIYA in Russian 16 Mar 91 Union Edition p 2

[Boris Konovalov report under "Direct Line" rubric: "Joint Flight May Become Reality"]

[Text] Moscow—The U.S. television company CBS has reported that "the United States and the USSR are working on the preparation for an unprecedented joint space exploration project."

According to the television company, the project expects that a Soviet cosmonaut will fly in the crew of a U.S. Shuttle reusable spacecraft, and that a U.S. astronaut will work on a Soviet Soyuz spacecraft with a subsequent four-to six-month stay on a Mir station. It is believed that the project will be realized within the coming 12-18 months. A similar report has been broadcast by the U.S. press agency UPI.

The IZVESTIYA editorial office asked Yu. Semenov, corresponding member of the USSR Academy of Sciences and general designer at the "Energiya" science and production association, who is the chief designer of Soviet orbital stations and manned craft, to comment on this information:

"Last year and this year," Yuriy Pavlovich said, "we had a number of contacts with leaders of the American space programs. In particular, I delivered a report in Washington on possible areas of cooperation. NASA Director R. Truly visited Moscow. At these and other meetings it was unanimously noted that USSR-U.S. cooperation in manned flights, has essentially broken off since the famous docking of the Soyuz and Apollo craft in 1975, and needs to be renewed. At the meetings the possibility of a U.S. Shuttle craft's docking with a Soviet Mir station and delivering a research module to it was discussed and the variant of a docking between a Shuttle and a Buran craft was looked at, as were the construction of lunar bases and a joint flight to Mars. Both sides found no fundamental barriers on the way to realizing these projects, but as yet there were no concrete official agreements.

"The CBS and UPI reports simply reflect the general desire of both countries to start real preparation for joint flights. The future will show into which concrete project this desire will be channeled, but I do not exclude even the variant circulated by U.S. media. Pooling efforts and—in the common interest—using the space potential of the Soviet Union, which has the world's most powerful rockets, could make complex projects considerably cheaper to achieve."

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25 April 1991